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THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

Publishing Office, No. 42 Pine Street.

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXVIII.—No. 3. Whole No. 447. | NEW YORK, SATURDAY, FEBRUARY 2, 1878 | $3 PER ANNUM IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, Editor,

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☞ An asterisk (*) denotes an illustrated article

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NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

OFFICIAL NOTICE.

The annual meeting of the Association will be held at the Tremont House, Boston, on Wednesday, February 20th, 1878, at 12 o'clock, noon.

At the last annual meeting of the Association it was voted that the sum of fifty dollars be paid from the funds of the Association to the member presenting the best original dissertation upon any subject connected with the manufacture of illuminating gas, from substances of which coal is the principal ingredient.

A further sum of fifty dollars was offered by Geo. D. Cabot, Esq., late President of the Association, to be devoted to the same purpose; thus making the prize or reward for the best dissertation, as stated above, one hundred dollars.

Members intending to compete for the prize are requested to forward their papers to the Secretary, at least one week before the time of the annual meeting, in order that he may lay such papers before the Directors for their inspection, giving them ample time for examination, and for a fair and careful examination of their comparative merits.

At the same meeting a special committee was directed to prepare a list of questions relative to the operations of the several companies under the charge of the different members of the Association; and that the Secretary cause said questions to be printed in convenient form and distributed among the members, to be answered by them and returned to him in season for their tabulation and presentation to the Association, at the next annual meeting. These questions will be forwarded to each member in a few days. The undersigned requests that the blanks may be filled out and the papers returned to him on or before the first day of February next.

The answers, in compliance with the wish of the committee, must be based upon the business of the year 1877, except in the case of those companies which do not close their financial year with the secular year. Their answers may be based upon the business of their financial year which closes the nearest to the date of this notice.

Members intending to propose any persons for membership at the annual meeting, are requested to send to the Secretary the names of such persons as soon as possible.

GEO. B. NEAL, *Secretary*,
BOSTON, Jan. 1, 1878.

THE PROPOSED DESTRUCTION OF THE 42D STREET RESERVOIR IN NEW YORK CITY.

It is painful to witness the passion for destruction which seems to be so firmly rooted in the minds of our people. It is now proposed to destroy the Reservoir on Fifth avenue, at 42d street, or to convert it into a barracks or armory for the Militia.

It would seem that a better use could be found for it in the line of duty for which it was built. It may not be needed to *distribute* the Croton water now, inasmuch as the larger reservoirs in the Park, built more recently, may answer that end; but it should not be removed. It should be made to serve as an auxilliary in giving the higher portions of the city a better "high service." By the erection of one or more towers, and proper pumps to force water taken from this reservoir to the tops thereof, a direct system of high service would be obtained much more efficient than that now in use, viz., bringing water in a 20-inch pipe for a distance of six miles or more. The time will come when all the high service power available at the High Bridge will be needed in the upper part of the city; and expensive work to increase that capacity, either from that point or elsewhere, will have to be done. Is it not better to make the best use of what we have at hand than to pull down and destroy it.

CREOSOTING WOOD.

An increased demand for one of the residual coal tar products of gas manufacture is likely to arise, at no distant day, for the purpose of preserving wood from rot, and from the action of the various marine worms that so rapidly destroy woodwork in salt water.

By permission of the Directors of the American Society of Civil Engineers, a paper of great interest in this connection was read before a number of members of the Society, and others, on last Tuesday evening, by Mr. E. R. Andrews, of Boston; specimens of wood work were exhibited, which had been treated 20 years ago, and in constant use in railroad ties which showed no signs of decay. The process, as described, oonsists in extracting the sap from "green" wood, placed "in vaccuo," and then filling the pores thus emptied of their sap with creosote oil under a pressure of from sixty to one hundred pounds.

Results obtained abroad have established the practicability of the process, and its perfect success in preserving timber.

It is a matter of great moment to many industrial interests in our country. Our rapidly disappearing forests may be made to endure for centuries—simply by the increased length of life given to timber, in all its uses, by this means; and should the system be generally extended, as it would seem it ought to be, the now almost marketless "creosote oil," which is the last product obtained in the distillation of coal tar before arriving at pitch, would find a legitimate use that would certainly enhance the value of coal tar on the right side of the residual products account.

Nomenclature of Building Stones and Stone Masonry.

[A Paper by James R. Croes, William E. Merrill and Edgar B. Van Winkle, Members of the American Society of Civil Engineers.]

PRESENTED AT THE ANNUAL MEETING, NOVEMBER 7TH, 1877.

Building stones are classified either in accordance with the manner in which they are individually prepared for use, or in accordance with the manner in which they are aggregated into masonry. The latter classification is in some measure dependent upon the former, as the nomenclature of masonry varies, not only with the combination, but also with the character of the work on the individual stone. The first named classification is that of the stone cutter, and the other that of the mason.

The object of this paper is to discuss building stones from these two stand points, with a view of obtaining a uniform nomenclature. The use of the same terms throughout the United States would prevent misunderstandings, and make engineering practice more uniform, and better understood when records of completed work are examined. The present diversity of nomenclature is unsystematic and objectionable on many grounds.

TOOLS USED IN STONE-CUTTING.

In order to describe intelligibly the various kinds of building stones, it will be necessary to begin with a description of the tools used in stone-cutting, as the names of many kinds of dressed stones are directly derived from those of the tools used in dressing them.

Formerly stone-cutters' tools were made of iron with steel edges; the modern practice is to make them wholly of steel.

The *double face hammer* is a heavy tool weighing from 20 to 30 lbs., used for roughly shaping stones as they come from the quarry, and for knocking off projections. This is used only for the roughest kind of work.

The *face hammer* has one blunt, and one cutting end, and is used for the same purpose as the double face hammer, where less weight is required. The cutting end is used for roughly squaring stones preparatory to the use of finer tools.

The *cavil* has one blunt, and one pyramidal or pointed end. It weighs from 15 to 20 lbs. Used in quarries for roughly shaping stone for transportation.

The *pick* somewhat resembles the pick used in digging, and is used for rough dressing, mostly on limestone and sandstone. Its length varies from 15 to 24 inches, the thickness at the eye being about two inches.

The *axe* or *pean hammer* has two opposite cutting edges. It is used for making drafts around the arris or edge of stones, and in reducing faces and sometimes joints to a level. Its length is about 10 inches and the cutting edge about four inches. It is used after the point and before the patent hammer.

The *tooth axe* is like the axe, except that its cutting edges are divided into teeth, the number of which vary with the kind of work required. This tool is not used in granite and gneiss cutting.

The *bush hammer* is a square prism of steel whose ends are cut into a number of pyramidal points. The length of the hammer is from four to eight inches, and the cutting edge from two to four inches square. The points vary in number and in size with the work to be done. One end is sometimes made with a cutting edge like that of the axe.

The *crandall* is a malleable iron bar about two feet long, slightly flattened at one end. In this end is a slot, three inches long and $\frac{3}{8}$-inch wide. Through this slot are passed ten double-headed points of $\frac{1}{4}$-inch square steel, nine inches long, which are held in place by a key.

The *patent hammer* is a double-headed tool so formed as to hold at each end a set of wide thin chisels. The tool is in two parts which are held together by the bolts which hold the chisels. Lateral motion is prevented by four guards on one of the pieces.

The tool without the teeth is $5\frac{1}{2} \times 2\frac{3}{4} \times 1\frac{1}{2}$ inches. The teeth are $2\frac{3}{4}$ inches wide. Their thickness varies from one-twelfth to one-sixth of an inch. This tool is used to give a finish to the surface of stones.

All of the above-metioned are *two-handed*, or require both hands of the workman to use them.

The remainining tools to be described require the use of only one hand for each.

The *hand hammer*, weighing from two to five pounds, is used in drilling holes, and in pointing and chiselling the harder rocks.

The *mallet* is used where the softer limestones and sandstones are to be cut.

The *pitching chisel* is usually of $1\frac{1}{2}$ inch, octagonal steel, spread on the cutting end to a rectangle of $\frac{1}{2} \times 2\frac{1}{2}$ inches. It is used to make a well-defined edge to the face of a stone, a line being marked on the joint surface, to which the chisel is applied, and the portion of the stone outside of the line broken off by a blow with the hand hammer on the head of the chisel.

The *point* is made of round or octagonal rods of steel, from $\frac{1}{4}$-inch to one inch diameter. It is made about 12 inches long with one end brought to a point. It is used until its length is reduced to about five inches. It is employed for dressing off the irregular surface of stones, either for a permanent finish or preparatory to the use of the axe. According to the hardness of the stone, either the hand hammer or mallet is used with it.

The *chisel* of round steel of $\frac{1}{4}$ to $\frac{3}{4}$ inch in diameter, and about 10 inches long, with one end brought to a cutting edge from $\frac{1}{4}$-inch to two inches wide, is used for cutting drafts or margins on the face of stones.

The *tooth chisel* is the same as the chisel, except that the cutting edge is divided into teeth. It is used only on marbles and sandstones.

The *splitting chisel* is used chiefly on the softer stratified stones, and sometimes on fine architectural carvings in granite.

The *plug* a truncated wedge of steel, and the *feathers* of half-round malleable iron, are used for splitting unstratified stone. A row of holes is made with the drill on the line on which the fracture is to be made. In each of these holes two feathers are inserted, and the plugs lightly driven in between them. The plugs are then gradually driven home by light blows of the hand hammer on each in succession until the stone splits.

In architectural carving a variety of chisels of different forms are used. For most of these no specific names exist, and their shapes are varied with the special work to be done.

STONE CUTTING.

All stones used in building come under one of three classes, viz.—

I.—Rough stones that are used as they come from the quarry.

II.—Stones roughly squared and dressed.

111.—Stones accurately squared and finely dressed.

In practice, the line of separation between them is not very distinctly marked, but one class gradually merges into the next.

1.—UNSQUARED STONES OR RUBBLE.—This class covers all stones which are used as they come from the quarry without other preparation than the removal of very acute angles, and excessive projections from the general figure. The term "backing," which is frequently applied to this class of stone, is inappropriate, as it properly designates material used in a certain relative position in a wall, whereas, stones of this kind may be used in any position.

II.—SQUARED STONES.—This class covers all stones that are roughly squared and roughly dressed on beds and joints. The dressing is usually done with the face hammer or the axe, or in soft stones with the tooth hammer. In gneiss it may be necessary to use the point sometimes. The distinction between this class and the third, lies in the degree of closeness of the joints which is demanded. Where the dressing on the joints is such that the distance between the general planes of the surfaces of adjoining stones is one-half inch or more, the stones properly belong to this class.

Three subdivisions of this class may be made, depending on the character of the face of the stone.

(a.) *Quarry-faced* stones are those whose faces are left untouched as they come from the quarry.

(b.) *Pitch-faced* stones are those on which the arris is clearly defined by a line beyond which the rock is cut away by the pitching chisel, so as to give edges that are approximately true.

(c.) *Drafted* stones are those on which the face is surrounded by a chisel draft, the space inside the draft being left rough. Ordinarily, however, this is done only on stones in which the cutting of the joints is such as to exclude them from this class.

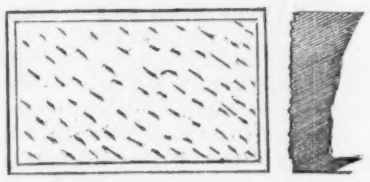
In ordering stones of this class the specifications should always state the width of the bed and end joints which are expected and how far the surface of the face may project beyond the plane of the edge. In practice the projection varies between 1″ and 6″. It should also be specified whether or not the faces are to be drafted.

III.—CUT STONES—This class covers all squared stones with smoothly dressed beds and joints. As a rule all the edges of cut stones are drafted, and between the drafts the stone is smoothly dressed. The face, however, is often left rough, when the constructions are massive.

In architecture there are a great many ways in which the faces of cut stone may be dressed, but the following are those that will usually be met in engineering work:

Rough Pointed, (Fig. 1.)—When it is necessary to remove an inch or more from the face of a stone, it is done by the pick or heavy points

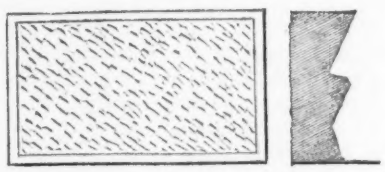
Fig. 1.



until the projections vary from $\frac{1}{2}$″ to 1″. The stone is then said to be rough pointed. This operation precedes all others in dressing limestone and granite.

Fine Pointed, (Fig. 2.)—If a smoother finish is desired, rough pointing is followed by fine pointing, which is done with a fine point. It is only

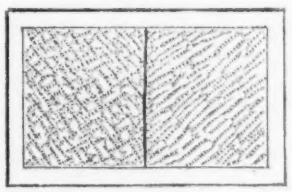
Fig. 2.



used where the finish made by it is to be final, and never as a preparation for final finish by another tool.

Crandalled, (Fig. 3.)—This is only a speedy method of pointing, the effect being the same as fine pointing, except that the dots on the stone

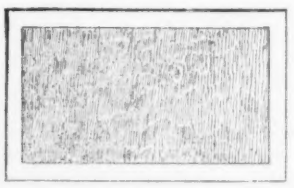
Fig. 3.



are more regular. The variations of level are about $\frac{1}{2}$", and the rows are made parallel. When other rows, at right angles to the first, are introduced, the stone is said to be *cross-crandalled.*

Axed or Pean Hammered, and Patent Hammered, (Fig. 4.)—these two vary only in the degree of smoothness of the surface which is produced.

Fig. 4.

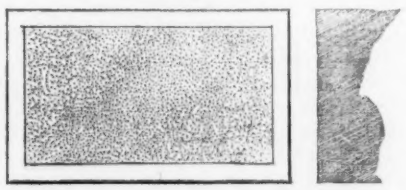


The number of blades in a patent hammer varies from 6 to 12 to the inch, and in precise specifications the number of cuts to the inch must be stated, such as 6-cut, 8-cut, 10-cut, 12-cut. The effect of axeing is to cover the surface with chisel marks which are made parallel as far as practicable. Axeing is a final finish.

Tooth Axed.—The tooth axe is practically a number of points and it leaves the surface of a stone in the same condition as fine pointing. It It is usually, however, only a preparation for bush hammering, and the work is then done with regard to effect so long as the surface of the stone is sufficiently leveled.

Bush Hammered, (Fig. 5.)—The roughnesses of a stone are pounded off by the bush hammer and the stone is then said to be "bushed." This

Fig. 5.



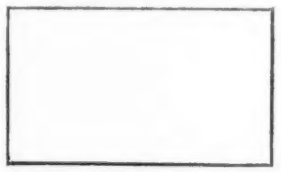
kind of finish is dangerous on sandstone, as experience has proved that sandstone thus treated is very apt to scale.

In dressing limestone which is to have a bush hammered finish, the usual sequence of operation is:

1st, rough pointing; 2d, tooth axeing; 3d, bush hammering.

Rubbed, (Fig. 6.)—In dressing sandstone and marble, it is very common to give the stone a plane surface at once by the use of the stone saw. Any roughnesses left by the saw are removed by

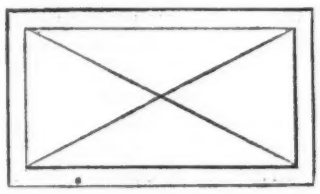
Fig. 6.



rubbing with grit or sandstones. Such stones, therefore, have no margins. They are frequently used in architecture for string courses, lintels, door jambs, etc., and they are also well adapted for use in facing the walls of lock chambers, and in other localities where a stone surface is liable to be rubbed by vessels or other moving bodies.

Diamond Panels, (Fig. 7.)—Sometimes the space between the margins is sunk immediately adjoining them and then gradually rises until the four planes form an apex at the middle of the panel. Such panels are called diamond panels, and in the case described, the panel is a sunk

Fig. 7.



diamond panel. When the surface of the stone rises gradually from the inner lines of the margins to the middle of the panel, it is called a raised diamond panel. Both kinds of finish are common on bridge quoins and similar work. The details of this method of dressing should be given in the specifications.

Masonry.

As the term stone masonry includes properly all classes of construction in stone which require the employment of skilled mechanics or masons, any class of masonry may be laid dry, in lime mortar or in cement mortar, at will. On this point specifications should always be precise.

RUBBLE

COURSED RUBBLE

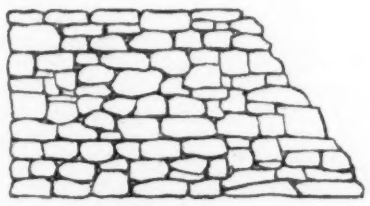


Fig. 8.

UNCOURSED RUBBLE.

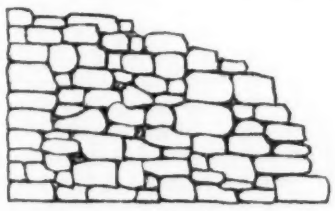


Fig. 9.

SQUARED STONE.

QUARRY FACED

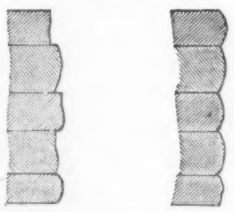


Fig. 10.

PITCH

Fig. 11

RANGE.

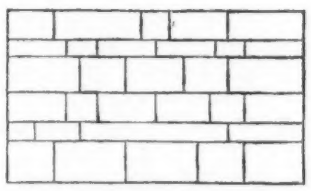


Fig. 12.

BROKEN RANGE.

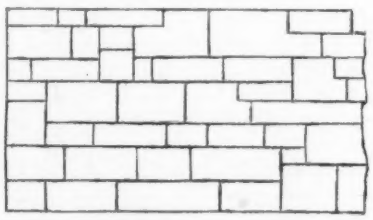


Fig. 13.

RANDOM.

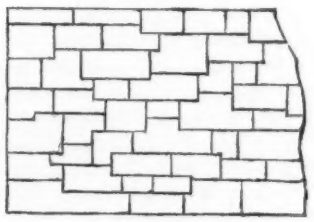


Fig. 14.

ASHLAR.

ASHLAR.

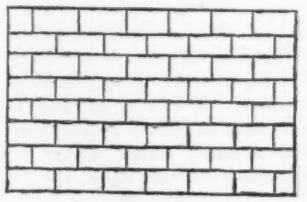


Fig. 15.

BROKEN ASHLAR.

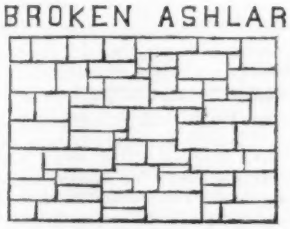


Fig. 16.

(1) Rubble Masonry.—This is composed of unsquared stones. It may be *Uncoursed Rubble* (Fig. 8), laid without any attempt at regular courses, or *Coursed Rubble* (Fig. 9), leveled off at specified heights to a horizontal surface. The stone may be required to be roughly shaped with the hammer, so as to fit approximately.

(2) Squared Stone Masonry.—According to the character of the face, this is classified as *Quarry Faced* (Fig. 10), or as *Pitch Faced* (Fig. 11). If laid in regular courses of about the same rise throughout, it is *Range* work (Fig. 12). If laid in courses that are not continuous throughout the length of the wall, it is *Broken Range* work (Fig. 13). If not laid in courses at all, it is *Random* work (Fig. 14), and this is generally to be expected of this kind of masonry, unless the specifications call for *Range* work.

In quarry-faced and pitch-faced masonry, quoins and the sides of openings are usually *hammer-dressed*. This consists in removing projections so as to secure a rough-smooth surface, and is done with the face hammer, the plain axe, or the tooth axe. This work is a necessity where door or window frames are inserted, and it greatly improves the general effect of the wall if used wherever a corner is turned.

(3) Ashlar Masonry.—This is equivalent to "cut-stone masonry," or masonry composed of any of the various kinds of cut-stone mentioned above. As a rule the courses are continuous (Fig. 15), but sometimes they are broken by the introduction of smaller stones of the same kind, and then it is called *Broken Ashlar* (Fig. 16). If the stones are less than one foot in height, the term *Small Ashlar* is proper. The term *Rough Ashlar* is sometimes given to square-stone masonry either "quarry-faced," or "pitch-faced," when laid as Range work; but it is believed that it is more logical and more expressive to call such masonry "Squared range work." From its derivation, Ashlar apparently means large, square blocks, but practice seems to have made it synonymous with "cut stone," and this secondary meaning has been retained for convenience.

Dimension-stones are cut-stones, all of whose dimensions have been fixed in advance. If the specifications for ashlar masonry are so written as to prescribe the dimensions to be used, it will not be necessary to make a new class of such stones.

Range work, whether of squared stones or of ashlar, is usually backed up with Rubble masonry, which in such cases is specified as coursed rubble.

Whatever terms are applied in common use, to various classes of masonry, it is not safe to trust them alone in preparing specifications for construction, but every specification should contain an accurate description of the character and quality of the work desired. Whenever practicable, samples of such kind of cutting and masonry should be prepared beforehand, and exhibited to the persons who propose to undertake the work.

Cast Iron Glazed Tiles.—The *Deutsche Allgem Zeitz.* says: At the iron works of Groeditz, near Riesa, Germany, glazed cast iron tiles for roofing are now made. They are not heavier than ordinary tiles and are very strong. The railroad depots of Loeban and of Reichenbach, and many private houses of Hamburg and Dresden are roofed with them.

Steel Rails for India.—Messrs. Steel, Tozer & Hampton, of the Phœnix Bessemer Works, Ickles, near Sheffield, have now completed their contract with the Indian Government for a heavy weight of steel rails for the extension of the Indus Valley Railway. The total quantity ordered from various firms in Wales, Barrow-in-Furness, Sheffield, and the North was 25,000 tons.—*Ironmonger.*

Waste of Gaslight.

BY MR. G. BRAY, OF LEEDS.

[A paper read on Thursday, August 2, before the Leeds Master Plumbers Association.]

The subject of waste of gaslight may, I think, be considered a new one. Waste of gas, by the use of bad gas-burners, has been, and is, a cry heard on all hands; but waste of gaslight is a child of the grumbler, which will have to wait some time yet, I suppose, before it arrives at vigorous manhood. Little as this fact in connection with gas illumination is thought of, I feel no hesitation in saying that one-quarter of the whole of the gas-light produced in places of worship and public entertainment, as well as in private houses and mansions, is wasted. What does this involve? The amount paid for gas in England and Wales in the course of a year is, in round numbers, about £9,400,000. Two-thirds of this amount, being £6,266,000, I estimate will be the cost of lighting the places named above; one-fourth of the latter sum, or £1,566,000, is the amount which I say is thrown away, and might be entirely and easily economized.

Before proceeding to the consideration of how this waste takes place, and how to provide a remedy, we will first inquire, so far as is necessary for our purpose, as to what are the physical properties of light. I need scarcely say light is the medium by which everything that is beautiful (and ugly) in nature is seen. Unlike the air we breathe, or any other physical property in nature, light has one of the five senses exclusively to itself, and cannot be made the vehicle by which any of the other four senses can be affected. Light diffuses itself equally on all sides, from its source. Though not quite, but nearly so, in the case of a flat gas-flame, it is pretty well known that light lessens in intensity the further we remove from its source. Its law of diffusion is in the inverse ratio of the square of the distance, that is, the light lessens as the square of the distance increases from the source of light; or to put it in another form, a gas-flame, throwing a given amount of light on an object at a distance of, say, one foot, will only throw one-quarter of the light on the same object if the distance be increased to two feet: if it be further increased to four feet, the light will be sixteen times less; and so on as the square of the distance increases.

Light travels in straight lines from its source, and illuminates with greatest power objects upon which it falls with most directness. Objects upon which light falls obliquely will be illuminated in a diminishing degree, in proportion as the obliquity is increased. If a book be held on the same level, or above the source of light, as is the case in some public places of assembly, the angle the book is usually held at is such that none of the direct rays of light can fall upon it, and the person holding it is indebted for all the light he has to the light intercepted by his own person, and reflected on to his book by his white face and white linen, aided by the light diffused by the solid particles in the atmosphere. In these circumstances it is not unusual to see the audience or congregation turning round with their backs to the speaker, in order to get the advantage of direct light.

Light cannot be caught and *weighed*, but it can be caught and *reflected* in an almost endless variety of ways. It is the most pleasing subject of order with which I am acquainted, being prompt and straight in all its movements, and its actions being always above board.

Light is also absorbed by the objects upon which it falls. A dull black object absorbs all the light thrown against it, and reflects none; and a white object reflects nearly all, and absorbs little; while absorption takes place in proportion as the color varies between white and black. All colored surfaces absorb light, and they do so in proportion as the shades are darker or lighter. A glazed surface always reflects more than a dull one of the same color.

Having now explained sufficiently the properties of light to assist us in understanding what follows better than we could otherwise have done, I now proceed to show in what directions I think the great waste of light takes place. And first, the wall papers and furnishings of our living-rooms and places of public resort have a great deal more to answer for in this respect than one person in twenty is aware of. It is no unusual thing for wall papers to be used in dining and other rooms, and wall decorations in public places, which will absorb 90 per cent, of the light thrown against them, and only reflect 10 per cent. back into the room. Other papers are used which absorb not more than 15 per cent., and reflect back for further use 85 per cent.; but these are, strangely enough, put into places which are least used, such as drawing-rooms and bed rooms. The difference between the dark paper, which absorbs 90 per cent. of the light; and the light paper which absorbs only 15 per cent. is, you will see, 75 per cent. against the dark one; but this does not represent the extra light which will be required to bring up the illumination of the darkly papered room to that of the lightly papered one, for this reason—a wall of the lightly papered room will reflect to the opposite wall 85 per cent. of the light it receives; 85 per cent. of this will again be reflected across the room, leaving 72 per cent. of the original light unabsorbed, after two contacts with the wall. and so the process goes on until the diffused light in the lightly papered room is increased to an amazing extent. In the darkly papered room 90 per cent. of the light is absorbed on its first contact with the wall, 10 per cent only being reflected to the opposite wall; and after this second contact, one per cent. is all that remains of the original quantity, as compared with 72 per cent. in the lightly papered room. The above result will, of course, be interfered with by anything in the room which absorbs or reflects the light. Modern fashion does not permit me to illustrate this phase of my subject, in our better class houses, with the strongest contrasts I might draw, because in these houses it is now scarcely possible to find a living-room with four whitewashed walls and ceiling; but it may easily be seen how much less light your lightly papered drawing-rooms take to illuminate them than your dark papered dining-rooms. There are hundreds—I had almost said thousands—of expensively papered dining rooms in Leeds which are worse lighted with their three, four, or five-light chandeliers than are most of our whitewashed cottage kitchens with their one naked flame. This light-absorbing power of colored surfaces will explain, to a great extent, why we have so many dark corners in our homes and places of public assembly. It will also explain why a large room can be lighted with a much smaller number of lights, in proportion to its area, than are usually required for small ones.

Table No. 1.

Absorbs per cent.	Reflects per cent.	
6	94	Unglazed White Paper.
15	85	Very Light Drab; about half of Pattern Dull, and half Glazed.
22	78	Half Dull Light Grey, and Half Yellowish White.
61	39	Very Light Dull Green, and Light Glazed Green.
61	39	Glazed Drab ground mostly covered with Dull Light Brown Figures.
88	12	Dull Brown ground, with Dull Black and Gilt Pattern.
91	9	Dark Red ground, with Black Leaf Pattern Edged with Gold. All Dull.
100	—	Dead Black.

In order that you may better understand what colored surfaces will do in the way of absorbing light, I have made some experiments with wall-papers, the results of which I have put in table No. 1, and I will read them to you; and here are the samples of the wall-paper I experimented with:

The different lifght-absorbing powers of these papers I can *practically* illustrate by the little apparatus before me, though we cannot by it gauge the result with scientific accuracy. It is a box having two compartments of the same size, representing two rooms and open at the front. In the center of each I have placed a gas burner, each consuming the same amount of gas, and giving the same illuminating power within one per cent. One compartment, you observe, is lined with unglazed black paper, the other with unglazed white paper. At the bottom of each box I have placed a card with various sizes of printing. You will readily see by this experiment that a much greater amount of light is absorbed in the black prepared box than in the white prepared one; and as I change the linings you will also readily see the difference between the white and other wall papers with which I contrast it.

These little experiments not only show the extent, but the contrasts being shown side by side, serve to impress one's mind with the facts more strongly than is done by ordinary every-day observation without the contrasts. If these facts and these contrasts could not only be laid before the Leeds master plumbers, but also before our architects, decorators, and the public, I cannot doubt that some of the color, which is now laid on so thick, would be used with a more sparing hand. It is piteable to see the color of the walls and furnishings in some of the hemmed-in places in London, where, from the grotesque positions in which you find the windows, you see that light is their great desideratum.

I am not a stoic in the matter of color—I rather delight in it—but I like it in its proper place. When decorative effect is required, which can only be produced by the use of dark colors, I believe in making use of them without stint. But where light and cheerfulness are counted of value, light colors should be the rule, and that this admits of elegance of design, our drawing room decorations abundantly prove. Of course, in all the features I have mentioned, and have to mention, taste will properly play a prominent part: but taste will be regulated to advantage by having the facts connected with utility to guide it, and these facts should never be left out of consideration when a room is about to be papered or furnished, or when the lighting of a public building is about to be arranged for.

TABLE No. 2.

	Sittings Lighted.	Burners Used.	Gas Consumed per Hour. Cub. Feet.
Oxford Place Chapel.	2200	73	About 292
East Parade Chapel ..	1865	99	About 306
St. George's Church...	1366	238	About 714
Victoria Hall.....	2000	1230	4000

In pursuing the consideration of the question still further, we will next see what is done in lighting matters in some of our places of public resort. I have obtained some particulars, which I have put in Table No. 2, of the lighting arrangement of St. George's Chapel, Oxford Place and East Parade Chapels, and the Victoria Hall, Leeds. I have taken these as samples, because they are all well-known places, and in the center of the town. The lighting arrangements are not worse—in the places of worship, at all events—than the average of such places, yet we shall find something to improve in all of them. The particulars in the table refer to the number of sittings, the number of burners used, and the gas consumed per hour for each place.

I mention the number of sittings instead of the floor area to be lighted, because I could more easily get at the former. The sitting space allowed is about the same in all the places of worship, except in the gallery of Oxford Place Chapel, where the space is somewhat less. In Oxford Place and East Parade Chapels, the total area to be lighted is very much larger than, and in St. George's Church quite as large as, the Victoria Hall. The particulars are as follows:

In this table, in speaking ot the number of cubic feet of gas per hour used to light each of the places of worship, I use the word "about," and I do so because it is a difficult matter to get at the exact consumption, as in all cases, except the Victoria Hall, other rooms were supplied from the same meter which supplied the church or chapel. In the Victoria Hall it is different, as there the consumption is taken by meters used only for that purpose, and the result given is what is actually consumed. In the church and chapels the burners were Bray's No. 4; in the Victoria Hall I think they were No. 3, but I could not get up to the chandelier to see the size. The consumption in these places, as you will see, varies immensely. St George's Church is splendidly lighted—to excess, I think—though it will require more gas to light it efficiently than either of the two chapels mentioned, because of its very dark colored walls and ceiling. To have them painted in this way is, of course, a matter of taste, which, in this case, I shall not attempt to argue against. The lights are well distributed, but I cannot say that I approve of the system of lighting.

Oxford Place Chapel is dimly lighted, and well it may be, with a consumption of 292 feet of gas per hour for 2200 sittings. The gas-jets are on the top of pillars rising from the pews, and are six feet six inches high in the body of the chapel, and six feet in the gallery. The lights in the body are well distributed, but badly distributed among the side pews in the gallery. There the top tier of lights is fixed three pews down, and instead of the light from these falling upon the books of those sitting in the top pews, it shoots into their eyes, and in sitting through a service the people in these pews are almost blinded, because of the lights intervening between them and their view of the preacher.

The alteration I would suggest here, regarding the position of the lights is, that the pillar-jets, in the gallery above alluded to, should be removed to the front of the top pews, and that the pillars throughout the chapel should be raised to a height of seven feet from the floor, so as to allow the light to fall more directly on the books of the congregation, and at the same time, be more comfortable to the eyes than is possible when the gas-jets approach the same level as the eyes.

Though 292 feet of gas per hour is all the congregation are allowed for lighting purposes, the small amount of light yielded by this is considerably diminished by covering the flame with a globe, and that too, of a very objectionable kind. It is of a form which keeps the flame in a constant dance; and just where the greatest amount of light should be allowed to pass through for the use of the congregation, a broad ground ring on the globe intervenes between the flame and the people, and the congregation may be seen working about to get into the most favorable line of light. These globes will keep from the congregation not less than 25 per cent. of the light they would receive if the globes were removed, and they distribute the light very irregularly.

Lighting by pillar-jets—the principle adopted in this chapel—can be made to give light to a congregation more economically than any other system I am acquainted with; but the principle carries with it, when the best is made of it, the grave fault of placing too many points of light in the line of view of those sitting in the pews furthest from the pulpit, and this fault more than outweighs the slight economical advantage it possesses over what I consider to be the best system, which I shall speak of presently. As applied in Oxford Place chapel, the principle there used is not carried out to the best dvantage, as I have before indicated.

In East Parade Chapel is consumed 396 feet of gas per hour for 1865 sittings. For this consumption of 16-candle gas, with naked flames, a place of worship of this size, and with the same colored furnishings, may be efficiently lighted. The principle of lighting here adopted, if properly carried out, has fewer defects, in proportion to its advantages, than any system I know of. The light is only slightly less economically used than by the Oxford Place Chapel system, but the noticeable defects of that system are all removed. It is the Oxford Place system, used to a point where its defects would begin, and another system is there introduced which avoids the former's defects. The eyes of those sitting in the back pews of chapels lighted like Oxford Place is, become dazzled by having to run the gauntlet of too many points of light before getting a view of the preacher; whereas, with the mixed East Parade system, all the central pillar lights are removed, thereby giving the congregation an uninterrupted view of the preacher and of each other; the latter being, I am sure, no despisable advantage to the fairer portion of a congregation.

Though this is the best system to which I can direct your attention for lighting a place of worship of this description, yet it can be improperly carried out, as you may suppose. I will briefly describe the arrangement. The seats furthest away from the pulpit, in the bottom, are lighted with pillar jets, which rise from the pews. The seats farthest away in front of the pulpit, in the gallery, are lighted with two small star-lights, hung from the roof, and fixed in a good position for their purpose. The inner circle of pews at the bottom and top, including the whole of the gallery side pews, receive their light from a large star hung from the roof, over the center of the opening in the gallery. This central star should be considered the leader of the system of lighting, and should be properly supported by the auxiliary lights, but to some extent this is not done here. The central star gives more than sufficient light to the people, in the inner circle at the bottom, and in the gallery, but the two top tiers of pews on either side of the gallery are miserably lighted. The excess of light, which those in the central parts would rather be without, is worse than useless to the upper side tiers of pews, because the central star-light is hung so low (a little too low I think), that the light therefrom shoots into the people's faces, and over the tops of their books, instead of falling upon them. The result is seen by the congregation in these pews turning their backs on their respected pastor, in order, for the moment, to get the light they require from another source. These defects are not at all connected with the system. What is wanted to remove this defect is, that pillar-jets, or jets hanging from the ceiling, should be provided in the neighborhood of the upper side pews in question.

The Victoria Hall, Leeds, is the best illustration I shall give on this branch of my subject, and it will serve to show better than anything I can instance in Leeds how to spend money in wasting gaslight. This hall, as you may be aware, is lighted by two chandeliers on the orchestra, and ten chandeliers in the body of the hall. You will probably not be aware of the number of burners in use; I will therefore give them. The orchestra chandeliers have 130 for the two; those in the hall have 110 each, being 1100 for the ten: these, with the 130 before mentioned, give 1230. The hall will seat with the enlarged orchestra 2000 people, so that you see we have 1230 gas-jets, consuming 4000 feet of gas per hour, used to give light to 2000 people; while the jets in East Parade Chapel give quite as much light in the aggregate to the people as is given to those in Victoria Hall, and this is done with a consumption of 308 feet of gas per hour, consumed by 90 burners. To put it in another way, the people in East Parade Chapel may be properly lighted, with the slight alterations I have mentioned, with a consumption of 21 feet of gas per hour per hundred people, while those assembled in the Victoria Hall have spent upon them 200 feet per hour for every 100, with no more light. I sometimes imagine what a sight the floor of the Victoria Hall would present if the 1230 gas-jets were distributed among a 2000 audi-

ence. The hall would be in a perfect blaze There would be sufficient light, if properly used, to l'ght all the people from their homes to the hall, give them light while there, light them home again, and have plenty to spare to take them to bed. This is simply a scandalous waste of gaslight, and when architects go so far astray as in this case, I should like the gas-fitters of Leeds—or any other town—to be able to get them straight. The cause of the waste is perfectly clear.

The chandeliers are raised so high as to give one the impression that they are intended to illuminate the heavens, rather than the poor mortals, who have paid to be amused or instructed, on the floor of the hall. The chandeliers being placed so high is one reason why so much gas shows so poor a result; but the main reason is, that three-fourths of the burners are so placed as to produce no appreciable illumination on the audience. As you will be aware, the chandeliers are shaped something like a bell-pear, hung as the pear grows, and are mainly composed of glass. The lights are arranged round two circles of glass dishes, the top circle being composed of five dishes, round each of which are fixed six burners, the lower circle being composed of ten dishes, round each of which are fixed eight burners. All the inside lights only serve the purpose of illuminating the chandelier, which is so dense as to possess neither reflective nor refractive power, which is of much use for transmitting the light to the audience. The lower interior lights, in addition to being useless in the position in which the chandeliers are placed for giving light to the audience, shoot their products of combustion up to the lights above, and keep them in one incessant dance. It will require no argument of mine to convince any one that lights interfered with in this way by a spent atmosphere cannot be doing their duty as illuminating agents. The chandeliers being placed close to the wall, and within recesses formed by the columns supporting the roof, one half of the whole of the light is wasted on the dark wall and pillars, which absorb the light, and from which scarcely any is thrown down upon the audience.

I think great liberty should be allowed to architects in embellishing a hall like this, but the liberty should not be allowed to run mad, as it has done in this case. These same chandeliers might be used in the same posltions they are now in, and yet save nearly half the gas they consume, at the same time giving as much light, and a great improvement in effect. It may be done in this way: I would stop off the inner half of the lights (400 of them, which are never seen) which surround the lower tier of dishes. The products of combustion from these would not then disturb the lights above, and their dancing would cease; the top lights would then develope their illuminating power, and show themselves steadily and effectively to the audience. I would also bring out the chandeliers a foot further from between the pillars, which would bring into use many of the lights which are now kept out of sight, which, besides giving more light would show the chandeliers off to better advantage. That these results would follow these alterations I do not think any gentleman before me will doubt. Thus, we see that much may be done with a proper use of our material, without marring, in any sense, the designs of our artists. In passing from this subject, I may just venture the statement that if five of these chandeliers were hung down the center of the hall, though perhaps not looking so well architecturally, it would be more efficiently lighted than it is now; and I know sufficient of the science of acoustics to give a confident opinion that the acoustic properties of the hall would be immensely improved thereby.

I might mention other public places of resort wherein gas is allowed to flare away, and the light it produces wasted, as if it were a thing as costless as the air we breathe; but this is not necessary, and I will pass on, and entering the houses of both the great and lowly, we shall find that waste of gaslight is as freely indulged in there as in the places I have before alluded to.

Here, almost at the very threshold, we are met with burners ill adapted to the purposes they have to serve, and it is a difficult matter, seeing the waste of gas that is going on, to pass them by, and in order to keep to our subject, deal with the waste of gaslight, which, it is important we should bear in mind, is the subject we have to-night in hand.

In our arrangements for lighting up the rooms we live in, it is important to bear in mind the principle before mentioned—that the power of light diminishes, not simply in the same ratio as the distance increases, but in the greater ratio of the square of the distance; therefore, all the lights in a house should be placed as near as possible to the objects they have to serve, and I need not say should not be placed under a bushel.

The most serious source of the waste of light that takes place inside our homes is the apparatus connected with our chandeliers, brackets, etc., which is made to surround the gas-flame. This apparatus has been constructed to gratify modern taste, and is composed, as you know, of globes, coronets, globe-holders of various thicknesses of metal, and pieces of metal, called ornaments, underneath the globe-holder.

I am not intending to find fault with the makers and designers of the various articles to which I am here taking exception, or with the architects or gas-fitters who use them. All classes of people have, no doubt, done their best in their separate departments; and it is not to be expected that an art which is of such vast importance, and which has sprung so rapidly into existence as that of gas lighting, should have grown to perfection with equal rapidity. Besides its rapid and vast growth, there has been no class of tradespeople who have been commercially interested in producing the most satisfactory result from the manufacture of the gas, right away through all the systems and arrangements it has to pass through, to the development and application of the light at the finish. There has been no one recognized line to which all trades connected with the art had to work; so each, taking his own course, has helped to produce the results which I to-night am trying to do something to remedy. Our chandelier makers have designed the metal parts connected with the globe, guided, doubtless, by appearances only, and regardless of the effects they would have in obstructing the downward passage of the light.

For a globe-holder nothing is required but the three forks projecting from the center, with the necessary screws, and all as light as possible for the purpose. We want nothing that will obstruct the downward light to the desk or table, or that will cast a shadow in any direction, if that can be avoided. To help in accomplishing this, have no thick (or thin) metal rings round the globe-holder; and underneath the globe holder have no saucer-shaped pieces of metal, or metal of any description, except the gas-pipe. I have seen some remarkable instances of light being obstructed by the fittings on our chandeliers.

In the house of a scientest in this town, to whom I occasionally pay a visit, is a chandelier having some pretensions to elegance. Being there on one occasion, the good lady of the house being busy with some needle-work, I saw her moving her work about from point to point on the table, trying to get within the rays of the light which ought to have come freely down from the chandelier above. "The light is bad," said this good lady; and I am not sure that both she and her husband did not decide that the gas was bad. I at once saw what was the matter. The outlet for the light was closed up with the massive globe-holder and this ornamental thing, which I have brought for your inspection, and in which you will no doubt see old friends similar to those which you will have in your chandelier rooms, and will often have met with in your business journeyings. I removed the ornament: the holder I could not remove, as I had not a proper one to replace it with. The result was a decided surprise to my friends, who could see to read and sew with comfort, the light being afterwards increased by putting on suitable globes and globe-holders. As this result was produced without any increase in the consumption of gas (as I did not change the burners), I have often had a pleasant chaff with my friends regarding the wonderful result produced out of nothing.

The "terra cotta" coronet is one of the worst gaslight washers, as compared with the good it has in it, which I ever remember to have seen. It is supposed to prevent the ceiling being smoked, and this it does to some extent, immediately over the burner; but what it saves in this respect is simply distributed over a larger area without throwing less dirt on the ceiling in the aggregate. At what cost is this obtained? The whole of the top light is obstructed, and a pall-like shadow, blacker than the worst blackened ceiling I ever saw, overhangs a room wherever those coronets are used. There is a little light reflected down by them, but that is infinitisimal, as compared with what they obstruct. Therefore, I say, "Discard the 'terra cotta' coronet absolutely as a worthless article."

The gas-globe is an ornamented article, for the honor of the introduction of which I have not been able to find an owner. It is scarcely anything else than ornamental, and that it is ornamental I am glad to have this opportunity of bearing testimany. I have often felt great pleasure in examining the well-executed designs, and the well stocked show-rooms which I have sometimes the privilege of entering; but our designers of globes having to think only of what will please and sell, have no inducement to keep their designing within the bounds of what is useful; consequently, there is no wonder they travel outside those bounds, and that we should find to-day that there is considerable room for improvement. Globe-makers are not entirely to blame for all the defects one meets with in the globe. They make what they find to be asked for, and sometimes they are asked for strange articles. People having got plenty of gas-light, want something to "modify the glare;" but they want this, possibly without thinking that light will be obstructed; that thought is left out of view, and they look only to having the "glare" modified. To meet this requirement, globes are offered to them thickly covered with figures, or with the whole surface ground; and latterly opal globes have been introduced to effect the same object, and the result they give is very pleasant to the eye. But what about the cost of all these things? When designers of globes, chandeliers, terra cotta coronets, etc., have done their best in nursing that interesting phenomenon—a gas-flame—and when people's tastes have been gratified to the fullest extent in these matters, the result of it all is that the light produced by the naked flame is obstructed to the extent of 70 per cent. Now there is no wonder that when people have succeeded in having their gas lighting apparatus beautified up to this point they then find out that "they want more light," that "the gas is poor," etc.

In making choice of globes, the public require and ought to know what the whole effect upon the light will be. Most of the gentlemen here present will be pretty well aware that these articles seriously interfere with the passage of light from the flame to the objects intended to be illuminated; others there may be who have had their minds opened to these facts, but the impressions from which have been allowed to slumber, and are, perhaps, now asleep; and generally there is an indifference which is, perhaps, excusable, seeing the multifarious and important duties a plumber is called upon to perform. But it is this indifference, if it exists, which I want to turn into interest.

I will give a few particulars regarding the light-obstructing power of globes, and then show you the effect practically in the apparatus before me. Clear glass obstructs from 10 to 15 per cent., according to its thickness and quality; ground glass obstructs from 25 to 40 per cent.; and from that to clear glass the loss is in proportion to the amount of ground or figured surface on the globe. Opal globes obstruct from 35 to 60 per cent. of the side light, according to the thickness of the glass, but give a good downward light if the hole be large, and the holder light and

free from ornament underneath—not otherwise—and are pleasant to look at. As a rule, when people get fitted up with opal globes, they are pleased with what is lasting. It is no uncommon thing for them to make the discovery, after the first freshness of the pleasure is gone, that "they cannot see to read at a distance," as they could before. The idea of increased light, which some receive when first entering a room where those globes are used, is the result of an optical illusion. The globe presents a great luminous mass which is cheering to look upon, as is a bright fire. The light is not too intense for the eye to look upon with comfort, whereas, when a globe is used through which the flame can be seen, the light is not so cheering, because it is too bright to be looked at with comfort; and, whenever the eye comes in contact with the flame, the lighting of the room suffers by comparison therewith, just as in passing from a brilliantly lighted room into the gas-lit streets, the latter appear dark until the eye gets accustomed to the change. Further, when opal globes are used, the space surrounding them is always much darker than is the space underneath, and the actual underneath light appears greater than it is, because of the contrast with the surrounding comparative darkness. In my opinion opal globes are simply a passing fashion, which will soon begin to wane, because the light they obstruct will never be tolerated as a permanency.

If the "glare" of light is to be modified, ground glass will do it with less loss of light than opal, and when ground glass is required for that purpose, the under part of the globe should always be clear, which arrangement will allow a free passage for the light downwards. Where globes are used simply for ornamental purposes, there is ample room for the exercise of the designer's art, without having the utility of the globe so seriously diminished by covering so much of its surface with figures, as is generally the case. In figured globes, as well as ground ones, the underpart should always be clear.

I now come to speak of a part of the globe which I have taken specially in hand to improve, and which not only interferes with the downward passage of the light, but also destroys the steadiness of the flame. I allude to the opening in the bottom of the globe. I have no idea to whom the honor belongs of fixing the diameter of this part at two inches and under, but it is utterly inadequate for its present requirements. The column of air it admits is too limited and confined. In its upward rush the air too rapidly oxidizes the centre of the flame, and curls up its edges, which becomes oxidized too little, and smoking points are the result, with great unsteadiness, which rises sometimes into a roar when the pineapple-shaped globes are used. Further, the holes being so small, it is difficult to apply a light without smoking the globe and holder, and the globes are difficult to handle while being cleaned, and are difficult to hold while being cut by the maker.

Seeing this long catalogue of objections scored against it, it is not very clear to me why the feature should have existed so long. I cannot but assume that the evil has been felt; but I am not so sure that the remedy has been so clearly seen. If the remedy had been seen, two considerations would, I think, have great influence in deterring globe-makers—and, may I add, gas-fitters—from attempting a remedy. 1. Under the new order of things, only one globe would be required for one gaslight, and that number is already required; therefore there is no commercial reason there to induce them to be at the trouble of attempting a change. 2. The guage being almost universally fixed at two inches, the evil is too ponderous to be grappled with. The evil is undoubtedly great, and what makes matters worse, it is rapidly growing. This makes it the more necessary that something should be done to stop its course, and I have decided to take the initiative, and trust to obtain your co operation.

The plan I propose for effecting this object is the following: Instead of the two-inch opening generally used, I propose that it should be altered to three inches. This alteration allows the flame to spread itself properly, and develop its illuminating power, and imparts to it steadiness, also giving much more downward light than the 2-inch hole; the globes and holders are not dirtied so much by the lighting of the gas, and are more easily handled and cleaned when dirty. The difference in effect of two globes of precisely the same pattern, with the exception of the holes, when placed over two similar gas-flames, is so striking, that I am satisfied the earnest attention of the trade only requires enlisting in the cause in order to have the change rapidly effected. I will again make use of the apparatus before me, and you will see the difference in the effect produced by the two kinds of globes. In the old globe you see the light dancing about, and in the new one almost perfectly steady, with an immense increase in the downward light. I think if you would try the experiment of having one of the new globes on one arm of a chandelier, and one of the old kind on another arm, in your own sitting-room, so that you can observe them constantly, your admiration for the new one will grow, until your dislike for the other grows to almost perfect hatred, and you will become, I think, fixed converts to the proposed new order of things.

I know there are eight to nine inch opal globes with 4-inch openings at the bottom, but these are not suited, nor are they intended for general use, and they are not the sizes I am speaking of. There are 7-inch opal globes with 2½-inch openings, but 2½ inches is not worth altering for, and that does not accomplish the end sought. I want the alteration made for every kind of 7-inch globe, no matter whether it is opal, or the kind more commonly used. A large number of these globes are already in use, and I have never heard a word of anything but praise regarding them. I may mention that I have no interest of any description in advocating this kind of globe, save the honor of being the author of such a desirable change.

Coming now to the close of my remarks regarding "Waste of Gaslight," and the remedies that may be applied to prevent the same, I would draw your attention to the consideration that the waste of light is not simply a question of pounds, shillings, and pence, but it is also a matter which has to do with the health and bodily comfort of those using it. Though lighting by coal gas has been almost unmixed comfort, yet it has not been quite so. We are all familiar with the fact that the atmosphere of our rooms becomes vitiated in proportion to the gas consumed therein. Efficient ventilation would remedy all this, but that is scarcely to be found; therefore the less gas we can use to adequately light our rooms the more healthy and comfortable they are. That an immense deal can be done to make them more comfortable I think I have fully shown in the remarks and experiments I have made.

Of course, I cannot tell what may be the outcome of this paper, but I should like to feel that it will be the commencement of an era wherein greater interest will be taken by the master plumbers of Leeds—and by them be communicated to their workmen—in one of the most important branches of their business. Before writing this paper I talked the matter over with some of your members, and the comments were varied. One said, "It is no use trying to move the master plumbers out of the old ruts, because it can't be done," others were doubtful as to the possibility of rousing the interest I wish, while one of your members to whom I mentioned the matter gave it as his opinion that the business of plumber and gas-fitter would be a very different matter in a few years time to what it is now, and that a better technical knowledge of the various branches of their business would have to be acquired, in order to ensure success: and he thought that very much good would be done by the reading a paper of this description. I am inclined to the latter gentleman's belief. It will be readily admitted, I dare say, that sufficient knowledge of this subject has not hitherto been displayed, and if some of you were to see the comments made regarding gas-fitters work and knowledge by our gas authorities, you would think that there were either some mistaken opinions being expressed, or that some improvement was desirable and must be made. I cannot always agree with the censures which are hurled indiscriminately at gas-fitters, because I think too much is generally expected of them. It frequently appears to be forgotten that the art of gas lighting, in all its varied forms, has sprung into existence in little more than a generation, and that alterations—not always to call them improvements—have almost too rapidly succeeded each other to allow of accurate knowledge being obtained regarding them, particularly by gentlemen who have so many other duties to perform as have our modern plumbers and gas-fitters; but these are only strong reasons why more interest should be taken in the matter. Another reason is that our gas authorities are everywhere becoming dissatisfied with what is done for gas consumers after the gas supply leaves the company's hands, and the question is being agitated by the companies as to the advisability of taking the gas-fitting business into their own hands. This, I feel confident, as a rule, is not what they desire, because they have more than sufficient to do in their own scarcely ever ending sphere, and would much prefer that the gas-fitters should be left in possession of their present field, if that can be done with some nearer approach to satisfaction than is now the case. Gentlemen, I now leave the matter with you, and only hope that my remarks may have been interesting to you.

[From London "Journal of Gas-Lighting."]

West of Scotland Association of Gas Managers.

DISCUSSION UPON SUGG'S ILLUMINATING POWER METER.

[Continued from page 30.]

Dr. Wallace (Glasgow): It would be very unfair for me to criticize this instrument, for the reason that I have not had an opportunity of working it. It, however, appears to me that it is simply an extension of the durability test, and that the ordinary straight flame might be used for the same purpose, or a number of straight flames in a row. It also appears to me that there is greater difficulty in estimating the length of the flame with a circular burner than with a straight burner. The top of the flame is not perfectly regular—points project here and there, and though no doubt, with practice, these might be overcome, still the beginner would have some difficulty in determining the exact length of the flame, and it is just possible that this might be found to be a serious difficulty. Single burners consume an equal quantity of gas, and they might be adopted with advantage. At all events they would give equal results. I would be glad to hear from Mr. Sugg whether he has ever thought of that, or whether he has ever experienced any difficulty with the length of the flame.

Mr. Sugg: The difficulty of using a straight jet with rich gases is just this:—Suppose you were going to use a jet for rich gases of nearly one quality, as you have them in Scotland, there will be no difficulty in producing a single jet for the photometer. Where the illuminating power varies you must have a jet for the standard quality. Then, the jet being open, the admission of air is more varied than with the Argand burner, where every passage is regulated. It is true that the points of the flame are slightly irregular; but that makes scarcely any appreciable difference in the illuminationg power. The same observation as that of Dr. Wallace was made by a speaker at the Institution of Civil Engineers; but previous to that meeting ten or twelve engineers tried the meter. They adjusted the flame for themselves, and tried the gas, and there was a difference of only half a candle to the whole of them. The points of the flame do not present any great obstacle. In fact, the points which are now visible are caused by draughts in the room. The instrument ought to be placed in a room specially prepared for it; and when this is done the points of the flame do not show themselves as they are doing now. But suppose a point is shown, it is

easy for a manager just to put a mark on the glass the exact shape of the points, and he knows how the points present themselves, so that he has no difficulty in arranging the flame. We have now used this meter for something like three years for the purpose of testing gas. In every experiment we record we make a mark to show where the three inch flame reaches, so that in repeating the experiment we can get the exact shape of the flame. Experiments conducted in this way, after the lapse of three years, have brought out the same results. It will thus be seen that the objection to these points does not rest on any strong ground.

Mr. Young: It has given me great pleasure to have listened to Mr. Sugg, and I should now like to say a word or two. Some years ago, at a meeting of the North British Association of Gas Managers, a most interesting paper was read by Mr. Macpherson, of Kirkcaldy, on the relation between illuminating power, condensation by bromine, and durability. Had Mr. Macpherson had the privilege, which I had, of looking over the figures in the book of Mr. Cusiter, my late brother-in-law, he would have seen that, although in some gases, and I may say in the great majority of cases, there was a relation between the two, yet the relation was not always exact. Indeed, from the very nature of illuminating gases, I cannot see how the durability and illuminating power could bear relation to each other perfectly consistent, because we know that a gas may be composed of certain per centages of various gases—that is, we may have a large quantity of hydrogen in one gas, and a small quantity in another. The hydrocarbon vapors in diffused gases have also a very different constitution, some of them having a much higher vapor density than others, and containing a much greater percentage of carbon in their constitution (volume for volume) and consequently having a higher illuminating power. It would, therefore, be quite in vain to expect that condensation by bromine and durability could bear any fixed relation to the illuminating value. If we were to curtail the supply of oxygen to the flame upon this meter, as I do now by applying a piece of tin plate to the mouth of the chimney, we immediately lengthen the flame, as you see, although we at the same time reduce the illuminating power. Now carbonic acid is the product of the combustion of carbonic oxide, and therefore I am of opinion that carbonic oxide in gas would have the same effect of limiting the oxygen. It will, of course, depend on the constitution of the gas how much the flame is affected in consequence of the carbonic oxide lengthening that flame, as the constitution of the hydrocarbons in the gas may be such as to considerably modify the action of the carbonic oxide in affecting the size of the flame. Now it appears that this is the case to a large extent, as the variations in the relation between the illuminating power and durability are never very great. I believe that the greatest differences will be found in the gases made from other materials than coal—such as the gases made from the oils derived from the destructive distillation of coal. In such gases little or no carbonic oxide is present, and consequently I would expect the durability to be much smaller in proportion to the illuminating power. I was very much struck, in making experiments on the process originally invented by Mr. Aitken, for the enriching of gases, to find that—when employing the analyser to enrich poor coal and water gases with the hydrocarbons derived from the richer coals—durability, condensation by bromine, and illuminating power bore no relation to each other. This, no doubt, was due to the constitution of the gases. I have drawn up a statement in a tabular form of the results of close upon 200 different analyses, made by my late brothe-in-law, showing the illuminating power, durability, and condensation by bromine. * * *

The table is so arranged that the durability successively diminishes; therefore, if the illuminating power and condensation by bromine bore a fixed relation to the durability, they should also successively diminish; but such is not the case, for I find here, with a durability of 67 minutes 50 seconds, an illuminating power of only 33 6 candles; and, in another instance, with a durability of only 66 minutes 9 seconds, there is an illuminating power of 35·10 candles. Again, on the other hand, with a poorer coal, and a durability of only 52 minutes 27 seconds, there is an illuminating power of 25·10 candles, and with a durability of 53 minutes 30 seconds, there is only an illuminating power of 23.30 candles. With a durability of only 48 minutes 57 seconds, we have an illuminating power of 23·10 candles; on the other hand, with a durability as large as 50 minutes 21 seconds, we have an illuminating power of only 21 candles. In the case of a very poor coal, with a durability of only 42 minutes 51 seconds, we have an illuminating power of 17 candles; and similarly, with a durability of 45 minutes 36 seconds, we have an illuminating power of 15·34 candles. These discrepancies may be due, as has been pointed out by Mr. Sugg, to the candle used by my late brother-in-law. Indeed, these errors may all be due to that cause, and if such is the case this instrument will be a valuable one; but I think, in testing gases, there will be found certain discrepancies between the indications given by this meter and the photometer, though I do not think that in ordinary cases there will be any great difference. At the same time that I raise these objections, I may state I am of opinion that it is the most perfect instrument that we have for arriving rapidly at the approximate illuminating power, although I do not think it will ever be taken as an illuminating power standard, but only as relative mode of testing or checking photometrical results. If I had had time, I intended to have brought mixtures of gases containing the different proportions of various gases, and to have added the various hydrocarbons to them, and illustrated the difference in the durability in that way. However, I am sorry I have not been able to accomplish that task. Perhaps on some future occasion I may allude again to this matter. I may say it has given me great pleasure to listen to this paper by Mr. Sugg.

Mr. Sugg: I think I mentioned at the outset that you would see that this was a combination of Dr. Vivian's duration test, and a comparative testing by candles; but perhaps that escaped observation. With respect to carbonic oxide, there is no doubt if you put it into gas you will produce erroneous readings; but you must recollect that this meter is for the use of engineers. I have not tried the meter with petroleum gases. Generally speaking they range too high, and would require a burner specially adapted for them. I do not know that I ever heard of this thing being tried; but a friend of mine, in connection with a gas-works in London, has tried it with petroleum gas, and he got his reading with the one gas as well as the other. I cannot, however, give this as a fact from my own personal knowledge. I do not know how he carried out his experiments. As a test for gas derived from coal, the instrument has acted very well, and to enable the engineer to ascertain what he is getting out of his coal it will be found very useful. In regard to the ordinary method of comparison with the photometer, I am perfectly sure, from observations I have made, and from the results of these observations, that this instrument supplies a standard burner to the best advantage. In the case of London where the standard is 16 candles, if you have 17-candle gas it will not turn out so well, and if you have 15-candle gas it will destroy that gas down to something like 13, so that would be deceptive. The flame must be three inches with the "London" standard burner. If you go above or below that standard, the instrument does not give the proper illuminating power of the gas, therefore the method of using the standard burner in London is not the right way of doing it, from the fact that we are averaged to burn 5 cubic feet per hour. That is made compulsory, but in many cases it is not done. If the quantity is reduced below 5 cubic feet, a calculation is made by the rule of proportion. Then, though the Act of Parliament says that candles must burn 120 grains, nobody hesitates to take them from 118 to 135. If you never recorded any experiments, except when the candle burned 120 grains, weeks would elapse without any tests being made. I forgot to mention that we have used candles, some of which burn 108 grains, and when they burn that, the increased illuminating power per candle is very marked. When you burn up to 130 or 135, which I consider the normal quantity for a-sixth-of-a-pound sperm candle, then you get a flame with a smaller amount of brown on the top. That, of course, does not give so much light as when you get 108, which gives a short, bright, luminous flame. Their difference is most marked, and therefore I think it is more important, in using candles, to keep the flame as near as possible to 120 grains.

Mr. Niven (Dunoon): Mr. Young, in the course of his observations, made some reference to Mr. Macpherson's paper in regard to the durability test for illuminating power. So far as I remember the reading of it, by taking the average of the illuminating power, Mr. Macpherson was able to find a divisor, for different gases from 22 to 26 candles, and from 26 upwards he had another divisor, and he found these two divisors to be pretty accurate in arriving at the illuminating power. Mr. Macpherson showed that by taking the average there was a wonderful relation between the durability test and the illuminating power.

Mr. Stewart (Greenock): I have listened with great pleasure to Mr. Sugg's remarks upon his test-meter, and I think it will prove to be a very valuable instrument, as far as a comparative test is concerned. In Greenock we could test the apparatus very readily. We have the gas-testing office three miles from the works, and another at the works, and if we had an illuminating power meter at each place, the one would check the other. In this way a valuable series of tests might be made. I think myself that, for a small work, where a man has not time to test by the photometer, and, perhaps, not a proper place for holding one, the meter will be found to be a valuable instrument for checking the gas, and will be sufficiently accurate; but, in towns where people are troubled with gas testers, it will not do to depend altogethet upon it; but for most towns in Scotland it will be found amply sufficient.

Mr. Black (Old Kilpatrick): I have been working for some time with a jet, and a certain pressure. I find that with 4-10ths of pressure and a 3-inch flame you will get 28-candle illuminating power. I have tried the experiment, and it comes pretty correct. Of course, the richer the gas the higher the flame; but then you have only to add so many more 10ths to the scale, and it comes very nearly right. The only difficulty is with the chimney. I would like to get a standard chimney, so that we might arrive at the right thing.

Mr. Young: Mr. Niven has raised the question as to whether or not it was the average result of analysis which was taken by Mr. Macpherson to arrive at the relation between illuminating power, durability, and condensation. I have not the slightest doubt that was so; and this instrument is based on results of a similar description. Indeed, if you were to take the ordinary experimental meter, and, instead of putting down the durability in the shape of minutes and seconds, mark opposite, on the dial of the meter, the candle power which the durability would give, you would have this instrument; only in this instrument, instead of using a jet, you used this improved burner. In regard to the standard candle I have had some experience, having been engaged in the manufacture of candles for six years. I am quite at one with the other speakers that the candle is not a perfectly reliable standard. If the wick happens to be strained when the candle is being moulded, the moment a light is applied the joints of the wick are drawn down, and a different amount of light is given from that afforded by a candle in which the wick has been loosely suspended. In regard to the mixture of the candle material, it is almost essential that a certain proportion of paraffine or a similar matter be used to prevent the crystallization of the sperm used during the

molding. Candles, in my opinion, are all open to variation in consequence of this cause. We have recently heard of a new test by Mr. Vernon Harcourt. He has taken one of the hydrocarbons belonging to the marsh gas series—pentane—and, by diffusing it through atmospheric air, prepares a standard gas to replace the candles. I would like to have Mr. Sugg's opinion as to that, and also as to the employment of olefiant gas for that purpose. I understand that olefiant gas has been extensively employed on the Continent, and as Mr. Sugg has had a good deal of experience in continental gas matters, perhaps he would be able to give us some information on the subject. I have always been of the opinion that the standard should be formed of sometbing which we can get perfectly pure, and used in a similar manner to the gas to be tested, and nothing can be got more readily pure, in my opinion, than olefiant gas.

Mr. Sugg: I tried some experiments a few years ago in respect of a new standard invented by Mr. Crookes, which was somewhat similar to that referred to by Mr. Young. He produced a mixture of benzole and alcohol, and he burned that in a flame with a platinum wick. I tried the lamp, and I found that the variations were greater than the variations of the candle. The light was only equal to half a candle, and when we multiplied the results we found the variations very great. That variation was due to the deposit on the wick of a gummy kind of matter which prevented the wick from giving its proper light; but still, use it as you would, there was a differenoe between the results given at one time and another. Although the same quality of gas was always tried upon it, we could never get the same result, no more than we could get it from the candles: so I was not disposed to look at that invention with any great favor. I cannot say anything about the system devised by Mr. Harcourt, because I have not tried it. A gentleman in London, however, told me that he had tried the invention, and that he had obtained very good results. He takes pentane—a product obtained by condensing petroleum—and mixes with it a certain proportion of atmospheric air in a gasholder. The mode of operation is to pull up the gasholder to a certain height, and then to turn pentane into it. This flows on the surface of the water, and gives itself off in vapors. The gas he burns on two brass tips, representing candles. They are about 1¼ or 1½ inch separate. There are two holes in the tip, nearly a quarter of an inch in diameter, and from these you burn two jets of flame, and they represent the candles very well; but whether that can be adopted as a permanent standard, I cannot say. I do not think it can. A manufactured article like that would require to be manufactured by an official tester, who would always be inclined to make his pneumatic gas in his own way, so that he would have more trouble than at present. I think the tester prefers to have nothing to do with the article by which he is testing the illuminating power of gas.

Dr. Wallace: As an official tester of gas at four stations in Glasgow, I have a good deal of experience in the burning of candles, and I find them to be, on the whole, tolerably consistent in their rate of burning at one time with another. A good deal depends on the length of time you burn a candle, and I make it a point in testing gas to light the candle in such a way as not to melt the oil all away. Then I let it burn for ten minutes before I begin to test. If you allow it to burn an hour or an hour and a half, you will get a different test. Then, for testing burners, I use a gas standardized first from candles. I have a jet of gas provided with a separate meter, a separate pressure-gauge, and a separate governor, and I bring an arm of it exactly into the place of the candles. It is brought in so that it shall be exactly equal to two candles, and if you have the same gas burning all day you have practically two candles, and you are sure that the results are the same all through. I think by a little care in using candles they form a standard not quite so bad as it is called by some. At all events I have found mine pretty consistent. For instance, the gas is tested on the works at Dalmarnock, and at a station 1½ or 1¾ miles away, and the consistency is to about a quarter of a candle. Of course, in severe weather there will be more lost. In regard to Mr. Crookes's lamp, my experience coincides with Mr. Sugg's. I tried it, and gave it up as worse than candles. In regard to Mr. Harcourt's test, I have not had an opportunity of trying it; but I am afraid that it is too delicate a thing for ordinary gas testers to use. Many of these gas testers are not men of such high education that they might not make a slip in the preparation of the mixture, and a slight defect in the quantity of pentane, or excess in the quantity of air, would make the test more apart from truth than the ordinary candles. I could approve of the use of sperm oil. I think it could be more reliable than sperm candles, and I should be glad to see the day when we could give up using candles and adopt sperm oil. The great evil we have to contend with is that gas testers will not take the trouble that is necessary when using candles. With oil there could not be the same difficulty.

On the motion of the President, a cordial vote of thanks was accorded to Mr. Sugg for his paper.

[To be continued.]

Cheap Gas.

A NEW PROCESS TO BE TRIED IN PHILADELPHIA—GAS FOR FIFTY CENTS PER THOUSAND.

PHILADELPHIA, Jan. 12, 1878.

The trustees of the Philadelphia gas works, which are owned and conducted by the city government, have for some time been examining a new process for producing burning gas, whereby it is claimed, the gas can be manufactured at a cost of from twenty to thirty-five cents a thousand feet, a great reduction as compared with the $2.25 per 1,000 which consumers are now obliged to pay in this city. By the new process it is proposed to use what is called the slack or refuse bituminous coal dust, which can be delivered here at about $2·75 per ton, instead of the lump coal now used, for which, according to the official reports for last year, the city was obliged to pay $6.70 per ton. Another alleged advantage in the new plan is that the dust is injected into the retorts in a continuous current of dust mingled with steam, being converted instantly into gas, purer and with less waste of time and material than by the present practice of filling the retorts with about 200 pounds of coal which has to be baked several hours to yield only 20 pounds of very impure gas, leaving a residuum of 180 pounds of coke, etc., etc., and injuring the retorts by sudden cooling and heating in the process of changing and withdrawing.

The inventor of the new process, a gentleman from Washington, D. C., offers this city free use of his patent and improvements, provided the public are benefited by selling the gas to the consumers at fifty cents per thousand feet, which can be done, he claims, and still leave a handsome profit to the city. The gas trustees have examined the plans of the inventor of the atomic, or steam coal process, as he calls it, and have authorized him to experiment with his new method, provided the city is not obliged to pay the expenses, this body not having the right to spend any of their appropriations for such purposes, without the special approval of the corporation. The inventor, Mr. Crutchett, today addressed a communication to the Mayor, formally repeating his offer to make the city a present of the use of his patent, and guaranteeing the city a saving of from $10,000 to $15,000 a day on the nine million feet of gas manufactured here every 24 hours. Mr. Crutchett intends making the same offer to New York city.—*N. Y. Herald, Jan.* 13, 1878.

Arsenic in Ornamental Paper—G. Christal.—Not only paper colored green is known to contain arsenic, but frequently paper colored with aniline red has been found to contain it, and should be avoided, especially in dwellings.—*Amer. Chemist.*

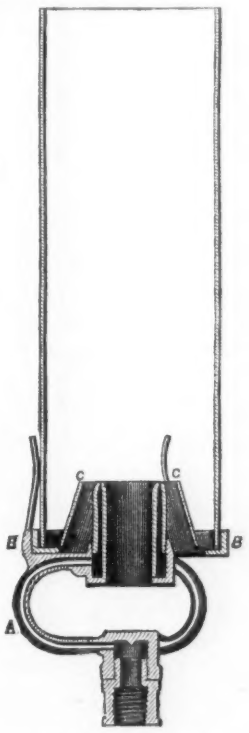
Gas Testing in the Metropolis.

The "Notification of the Gas Referees" for the winter half year, 1877–78, contains an Appendix giving a description of the standard burners to be used for testing common gas and cannel gas.

COMMON GAS.

The burner which has been adopted as the standard burner for testing common gas was designed by Mr. Sugg, and was called by him "Sugg's London Argand, No. 1."

A half-sized section is appended, in which A represents a supply-pipe, B the gallery, C the cone, D the steatite chamber, E the chimney.



The following are the dimensions of those parts of the burner upon which its action depends:

	Inch.
Diameter of supply-pipes	0·08
External diameter of annular steatite chamber	0·84
Internal diametar of ditto	0·48
Number of holes	24
Diameter of each hole	0·045
Internal diameter of cone;	
At the bottom	1·5
At the top	1·08
Height of upper surface of cone and of steatite chamber above floor of gallery	0·75
Height of glass chimney	6
Internal diameter of chimney	1¼

CANNEL GAS.

The standard burner for testing cannel gas is a steatite bat's-wing burner, consisting of a cylindrica stem, the top of which is divided by a slit of uniform width.

	Inch.
External diameter of top of stem	0·31
Internal diameter of stem	0·17
Width of slit	0·02
Depth of slit	0·15

—*Journal of Gas Lighting.*

G. J. ROCKWELL, late a student in the School of Mines, Columbia College, and one of the members in the Siberian party of the Transit of Venus Expedition, has been appointed Professor of Chemistry in the Imperial College at Tokia, Japan. Mr. Yamaoka, also a late student in the School of Mines, is acting as Assistant to Prof. Rockwell.—*Amer. Chemist.*

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

A. M. CALLENDER & CO.,

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Editor—G. WARREN DRESSER.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH

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LIGHT, HEAT, STEAM, WATER-SUPPLY,
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NEW YORK—AMERICAN NEWS COMPANY, 119 and 121 Nassau S
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PHILADELPHIA—COE, WETHERILL & Co., Ledger Buildings Phila.
Germany—B. WESTERMANN & Co., of New York.

SATURDAY, FEBRUARY 2, 1878.

Official Report of Examinations of Gas for two Weeks ending Jan. 26, 1878, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Date. Jan. 1878.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
14	Between 10 A. M. and 3 P. M.	17.24	16.45	20.06	17.05	16.57	
15		15.95	16.34	19.48	17.28	16.80	
16		15.93	15.64	19.86	16.91	16.36	
17		16.51	17.03	19.49	17.12	16.20	
18		16.21	16.60	19.12	17.14	16.48	
19		16.66	16.46	20.14	17.31	16.86	
	Average	16.42	16.42	19.49	17.13	16.54	
21		16.13	16.09	18.31	17.00	16.22	
22		15.68	17.11	18.13	17.49	16.58	
23		15.16	17.22	17.78	17.19	16.20	
24		16.85	17.19	19.16	16.81	16.13	
25		15.06	17.29	20.42	17.04	15.76	
26		17.01	17.12	20.54	16.09	16.58	
	Average	15.98	17.00	19.05	16.93	16.24	

Sugg-Letheby burner.

E. G. LOVE, Gas Examiner.

Preservation of Lime Juice.—Lime or lemon juice may be preserved as follows: Heat the juice, to coagulate all albuminous matters, and then sweeten with pure glycerine. The glycerine will not only retard turgid growths, but prevent the juice from freezing even during the coldest winters.

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED

A Serious Hidden Danger.

There is a crime for which the opportunity is given by modern building improvements, and for which there is no adequate punishment provided by our laws so far as we are aware. Something, a great deal more serious than larceny, is involved in stealing the gas fixtures from unoccupied houses. The loss and direct damages are bad enough, but the danger to which robberies subject other people than the owners of the despoiled property are much more threatening than most people are aware. For example, not a long time ago, the owners and occupants of dwellings on each side of an unoccupied house in one of the southern wards, found their premises filled with the stench of escaping gas. Each of them, unknown to the other, sent for gas-fitters, and had all their fixtures overhauled and every place examined for the purpose of finding the leak, but without avail. No leak was found in either house, but still the strong odor of large quantities of escaping gas pervaded both of them. At this time accident discovered the leak. Some one having to go into the unoccupied house between the two, was almost stifled by the presence of gas the moment the door was opened, and an after examination showed that the chandeliers and brackets had been wrenched off by some thief in that line, and that the gas meter had not been shut off as is usual with unoccupied houses.

It is solely the result of good fortune that there was not a destructive and fatal explosion among the houses referred to. If any one had gone into the closed house at night with a lighted lamp or candle, or had struck a match, the house and those immediately adjoining must have been badly shattered. Probably some one would have been killed. This is a constantly recurring peril, and must continue to be so long as the villains who strip dwellings of their water and gas fixtures can find other villains not less criminal than themselves to buy the goods thus stolen, and that every one to whom they are offered must know to be stolen. It is a peril that requires much stronger legislation on the subject in the way of remedy than we now have; and, as one obvious way of strengthening the law in this particular is to increase the punishment of those found guilty of the dangerous offence, it will be well for our legislators at Harrisburg to take the subject into consideration. The violent wrenching off of gas fixtures in an unoccupied house may cause as much destruction and loss of life as exposing an open keg of gunpowder to the chance of any stray spark that may come along.—*Phila. Ledger.*

PHILADELPHIA, JAN. 17, 1878.

Mr. Editor: Thinking the above would not be out of place in the columns of the Journal, I take the liberty of enclosing it for your consideration.

It is a matter in which all managers of gas works are, more or less, interested it being their duty to afford all the protection possible to the public against any accident which may arise from either the use or abuse of gas.

Aside from this, the interest of the gas companies will suggest the propriety and wisdom of shutting off the gas the moment a building is vacated.

If it cannot be done at the service cock, owing to another meter being supplied with it, shut and lock the meter cock; otherwise the company can be held responsible for any damage which may be sustained, even if the cock has been closed by the agent of the company and opened by a thief.

A case occured with a company in which the writer is interested.

The meter cock had been shut, and a thief had stolen one of the pendants from the back end of the store—which was vacant. The pendant became detached between the ceiling and the floor above—the upper part of the building being occupied.

The room was rented for one night to some colored brethren and sisters to have a supper in.

One of the most enterprising of the brothers thought they might as well have gas as not, and finding his way into the cellar, and to the meter, opened the cock. The escaping gas soon filled the space between the ceiling and floor; and, about an hour afterwards, while they were seated at the table, an explosion took place, dropping the plaster on their heads, and blowing out the windows and doors.

I need hardly say that there was a frightened crowd of darkies around there at that time.

We, as gas men, didn't begrudge the gas it took to frighten them, and continued to enjoy the joke until the Supreme Court of Georgia ordered us to foot the bill for all damages done. After that it didn't appear nearly so amusing. Yours, truly,

W. H.

Gas Poisoning.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN of the 15th is an article from the *Lancet* on poisoning from the common use of illuminating gas. The concluding period is: "It is not creditable to the ingenuity of practical men that no method has yet been discovered by which the advantage of gas as an illuminating agent may be secured without the drawback of slow poisoning, with the host of maladies a depressed vitality is sure to bring in its train."

I have seen in Europe an excellent contrivance to meet the difficulty alluded to. It consists in a glass globe of whatever size may be required for the apartment, whole at the bottom and illuminated with gas. The globe is closely connected with the fixture by which it is suspended, so that there can be no escape at the top of any of the products of combustion.

The fixture is of bronze, like that of a chandelier, about three inches in diameter, variously and tastefully ornamented. This fixture is connected with a small flue concealed by the plastering, and this flue communicates with the chimney or some other avenue to the open air. The products of combustion pass off through this channel, and air is admitted into the globe to support combustion by the same way through a small separate pipe. The air might be supplied through minute holes at the bottom of the globe.

The glass is often ground, but I have seen it elaborately cut, and the globes are sometimes as large as two feet in diameter. The result is a uniform and perfect light in every part of the room. N. D.

Portland, Maine.

Combustion of Petroleum.—It appears from the reports of the workmen in the various petroleum refineries that fires often break out in them in spite of all precautions, and without any visible cause. The *American Review* is authority for the statement that persons familiar with the refining of petroleum also say that, if cold water is poured on warm oil for the purpose of cooling it, the oil will sometimes suddenly ignite. It is unfortunate that, in this case, it is not certain whether it was water or steam which was applied, but if the fire arose from chemical action, the composition of the two substances was the same, only the high temperature and vastly extended condition of the oxygen in the steam might have caused it to unite rapidly with the carbon of any of the more volatile portions of the partially refined oil, which might by imperfect process, have been allowed to enter the agitator. Petroleum is not spontaneously ignitable in air under ordinary atmospheric conditions, but it is well known that spontaneous combustion, though generally slow in inception, often occurs rapidly from the quick absorption of oxygen from water or damp air by highly carbonized substances, of which special instances may be mentioned in lamp-black works, and places where charcoal finely pulverized is used.—*Mining and Scientific Press.*

Gas-Light Intelligence.

United States.

Election of Directors.—At a meeting of stockholders of the Houston (Texas) Gas-Light Company, held recently: T. W. House, T. H. Scanlan, H. S. Fox, John Shearn and J. T. Brady were re-elected directors for the ensuing year.

T. W. House was re-elected President.

T. H. Scanlan, Vice-President.

T. F. White, Secretary, Treasurer, and Superintendent.

Explosion in a Theatre—Almost a Panic in the Holliday Street Theatre—One Man Fatally Injured.—Baltimore, Jan. 23.—The explosion of an oxygen gas cylinder in the wings of the Holiday street Theatre this afternoon, just before the matinee performance, caused a great excitement, and gave rise to the wildest rumors of disaster and death. The house was well filled with people, and James Knapp, the machinist had gone to turn on the calcium light for the first act of "Evangeline." It is thought he turned the wrong cock, and the cylinder exploded with a terrific report, striking down Knapp, and throwing the audience into general consternation. The house was emptied in a moment, and Knapp was placed under the care of a physician, who decided that he will die.

The explosion was one of those accidents which no amount of foresight could have provided against, and is liable to occur wherever oxygen light is used to produce calcium light. The generator used in this instance is a copper cylinder, with a circumference of about forty inches, standing three feet high.—*N. Y. World, Jan.* 23.

Great Britain.

Explosion of Gas at Hamilton.—Last Tuesday evening, about nine o'clock, an alarming explosion of gas occurred in the house in Union street, Hamilton, occupied by Mr. Kemp, painter. The house consists of two apartments, and is in a one-storyed erection. For some days back the gas company have been renewing the mains in the street, and in course of the day had laid a branch of the main to Kemp's house. The workmen had insufficieatly plugged the end of the pipe, causing a great escape of gas. When the pressure was put on at the gas works a strong smell was felt throughout the house. Mr. Kemp and two other men entered with lighted candles to ascertain the source of escape, when a terrific explosion, which resembled the report of the bursting of a boiler, ensued. Strange to say, the three parties in the room at the time escaped uninjured, although they were thrown down with the force of the explosion. The floor was burst up, and the entire tenement—floors, windows, ceiling, and furniture—completely wrecked. The damage is considerable.—*Glasgow Herald.*

Chemical and Scientific Repertory.

Large Steam Hammer.—Krupp has placed in operation at his Works in Germany a steam hammer, capable of forging a piece of steel, weighing 50 tons, at a cost of $560,000. He proposed to establish a machine of double this capacity.—*Ibid.*

Researches on Electroplating with Bismuth.—Armand Bertrand.—Copper or brass may be plated with bismuth in a bath composed of 25 or 30 grammes of ammoniacal chloride of bismuth per liter of water, slightly acidulated with hydrochloric acid, operated cold. If heated to 100°, the bismuth will not deposit. A single Bunsen cell only is necessary; with a single Daniel cell the deposit is long forming, and but slight. On coming from the bath, the articles are covered with a dark deposit, under which is the bismuth with its especial brilliancy, and adhering strongly. By substituting the double chloride of antimony and ammonium, antimony may be similarly deposited.—*Ibid.*

Researches on the Tarry Matter of Commercial Ammonia.—M. Kupfischlaeger.—It is proposed to test the ammonia for these impurities as follows: Put the liquid in a tube with some colorless HNO_3 diluted with one-fourth its volume of water, and if these impurities are present, a currant-red color will appear immediately, and become brown in proportion as the impure ammonia is added. This brown is permanent. Heating the mixture will develop frequently a tarry odor Nitric acid is preferred above all others for this test Ammonia thus contaminated cannot be used to precipitate various oxides completely, nor for the manufacture of molybdate of ammonia.—*Ibid.*

Memoir on the Action of Alcohol on the Brain.—C. T. Kingzett.—After a series of experiments on ox-brain, the author concludes that alcohol has no more chemical effect on the brain-matter than water, when kept below a certain proportion to the total volume; when this proportion is exceeded, the brain principles, including kepheline, begin to dissolve.—*Ibid.*

A New Theory of the Nature of Water.—M. Maiche in *Les Mondes* propounds the theory reached after numerous experiments that water is simply hydrogen *plus* electricity, or oxygen *minus* electricity; or, in other words, that normal electrified hydrogen constitutes water, and that normal diselectrified oxygen produces the same; or that hydrogen, oxygen, and water are precisely the same, differing only in degree of electrification.—*Scientific American.*

Rendering Portland Cement Concrete Water Tight.—With reference to the discussion in recent issues of the Journal on the question of Portland Cement Concrete, our Glasgow correspondent quotes the experience gained by the practice at the Rothesay Aquarium. He says: "Concrete tanks can be made practically water-tight by first using a good stiffish body of concrete, just composed of such proportions as should be used in order to make a good job, judging by the quality of the cement. Use clean sand, thoroughly free from soil, and then give a coat, one inch in thickness, of *pure* cement, finished and *polished* as hard as possible. By adopting such a course of procedure the tank is practically water-tight. This is what was done in the large reservoir-tank at the Rothesay Aquarium, and it succeeded famously, whereas under the ordinary method it leaked like a basket."—*Journal of Gas-Lighting.*

Railway Bridge Over the Tay.—On Tuesday this bridge, which has been constructed to afford facilities for the traffic of the North British Railway Company was inspected and formally opened. It spans the estuary of the Tay at a point almost two miles in width. It has 85 spans, varying in length from 65 feet to 245 feet. The thirteen largest spans, forming about a third of the structure, are placed over the navigable part of the river. The rails are laid double throughout—that is to say, a service rail with a guard rail within, keyed into a double chair, and laid upon a continuous sleeper of pitch pine. The weight of the steel rails and chairs is given at 1 cwt. per foot, the rails themselves being 75 lb. to the yard. Mr. Eouch, the engineer of the North British Railway Company, designed the bridge. The first contractors were Messrs. De Bergue & Co., of London, who commenced the work in 1871, but owing to the death of the principal partner of that firm, the contract was in 1874 transferred to Messrs. Hopkins, Gilkes & Co., of Middlesborough, who have carried it on to completion. In the central section the bridge has 88 feet clear height above high water. With the main line of the North British Railway the bridge is connected by a branch line of about five miles in length. On the north side a junction is formed with the Caledonian line by a viaduct, and afterwards a tunnel carried alongside the Dundee Docks.—*Iron.*

A Volumetric Method for Estimating Sulphur in Coal Gas.

Sir: A quick and easy method of estimating the sulphuric acid in the liquid condensed by the Gas Referees apparatus has long been sought for, and has not yet been provided, unless the method I am about to describe be considered as meeting the desired end. There is a method of evaporating the liquid and weighing the dried residue; but, as will be seen, this cannot be correct, for the residue is considered and calculated as ammonic sulphate. In the scheming out of the method shortly to be described, the apparatus at present in use has been kept only in view, and there has been no intention of designing new apparatus. Before entering into a description of the proposed test, it would be well to consider the principal substances to be dealt with, and the manner in which they are obtained.

When coal gas containing sulphur (I have no experience of any other) is burned with ammonia, amongst the products of combustion will be found ammonic nitrate, nitrite, carbonate, and sulphate, with some half-burned organic matter. With the Gas Referees apparatus, the sulphate, nitrate, and nitrite are condensed apparently before reaching the top of the cylinder, as may be proved by fixing the eduction-pipe in such a manner as to give the liquid condensed therein a fall into a separate vessel, and not into the cylinder. As much sulphuric acid will be obtained in the cylinder, etc., as though the whole of the liquid condensed had been there; and the liquid condensed in the eduction-pipe, collected and treated independently, will give an almost unweighable trace of sulphuric acid. Push this experiment further by leaving off the eduction-pipe altogether. Of course, but little liquid is obtained—there is none if the gas has been burned rapidly, and the apparatus, consequently, very hot; but the ammonic salts will be condensed chiefly in the lower part of the apparatus. Now, oft-repeated experiments show that as much sulphuric acid is obtained in this manner as by the ordinary process—perhaps a trifle more; consequently, the eduction-pipe may be discarded or shortened. The old Letheby's and Wright's tests gave large quantities of liquor and low results; the Gas Referees apparatus, without eduction-pipe, gives practically no liquor and high results.

Suppose, however, the liquor obtained in the usual manner diluted with washings, and ready for estimation. Boiling will expel the ammonic carbonates, leaving the more fixed ammonia salts behind in solution with some organic matter. Then the addition of a known quantity of standard alkali (potash or soda) will, with boiling, expel the remainder of the ammonia. With standard acid, estimate the amount of alkali neutralized by acids that had been previously combined with ammonia. When by the process of evaporation, a residue is obtained, this is calculated as ammonic sulphate.

Now, with the substitution method above suggested, the following figures were obtained, the whole of the ammonia being calculated as sulphate. The gas was burned with ammonia as usual.

Rate per hour at which gas was burned in feet.	Sulphur per 100 cu. ft. per $BaCl$ gravimetrically.	Sulphur per 100 c. ft estimated from NH_3 volumetrically.
1·000	10·16 grains	12·48 grains
0·680	7 41 "	9·60 "
0·625	11·53 "	14·88 "
0·625	9·33 "	13·76 "
0·625	10·43 "	14·72 "
0·528	8·51 "	12·48 "
0·470	11·53 "	17·28 "

These figures show the large quantity of nitrogen acids formed when gas is burned with ammonia, which, however, decreases with increase of gas consumed. They show also that when results are obtained by the evaporation method, the error must be considerable, for there is also some organic matter weighed. Consequently, this substitution method is of little value when the gas is burned with ammonia.

Instead of burning the gas with ammonia, put the

ammonia, either as hydrate or sesqui-carbonate, in the base of the cylinder, remove the eduction-pipe entirely, or replace it with a small upright tube, about 4 or 5 inches long (this will keep the apparatus moist) and treat the washings by the method which is described above, and is called the "substitution method." Here are some figures obtained in this manner. The columns of figures are numbered 1, 2, and 3. Column 1 is the amount of sulphur per 100 cubic feet in liquor obtained with the ammonia placed in the base of the cylinder, and estimated with BaCl. Column 2 is the amount of sulphur per 100 cubic feet, estimated by the substitution method, in the same liquor as 1. Column 3 is the amount of sulphur per 100 cubic feet obtained by the Gas Referees method, with separate test burning by the side of 1:

1.	2.	3.
10·16 grains.	10·24 grains.	9·8 grains.
10·43 "	10·56 "	10·43 "
10·98 "	11·52 "	10·98 "
8·78 "	8·96 "	8·64 "
10·32 "	10·40 "	10·40 "
10·43 "	10·66 "	10·43 "

The average of a large number of tests gave the excess of sulphur per 100 cubic feet by this volumetric method, over gravimetric in the same samples of liquor, as ·2 grain—an inconsiderable quantity.

If this method be adopted with tests extending over a period of about 20 hours, the ammonia will have to be renewed once during the experiment, and keep the cylinder always alkaline. It is for such short tests that this method is more especially proposed. With one cubic foot, excellent results have been obtained by working on the whole quantity of washings. A convenient solution, if standard solutions are not at hand, is prepared by dissolving 414.06 grains of pure and dry sodic monocarbonate in one gallon of distilled water, or one-tenth this quantity in 1000 septems. An acid soultion exactly equivalent to this should also be prepared.

If the quantity of gas burned has been 10 feet, and one-fourth of the washings estimated, then each septem will represent ·5 grain of sulphur per 100 cubic feet; or, if 2·5 feet be burned and the whole quantity treated, the same amount will be represented.

Directions for the use of these solutions are as follows:—Put the quantity of liquor to be estimated for sulphur in a beaker with 100 septems of alkali solution, then boil briskly, but in such a manner as to avoid loss, until no ammonia is evolved. This point is best determined by placing over the beaker a watch glass, and testing the steam, that has been condensed thereon, with delicate litmus paper; then stand aside a few minutes to cool a little; add some cochineal solution, and carefully run in the acid solution from a burette until acid reaction occurs. The number of septems used deducted from 100 and multiplied by 5 will give the quantity of sulphur per 100 cubic feet. If the sulphur in the gas is likely to be more than 50 grains, of course more alkali solution should be used. The advantages of this method for small quantities of gas, or what are called "quick tests," are obvious.

LEWIS THOMPSON WEIGHT.

—*London Journal of Gas-Lighting*, Nov. 13, 1877.

Thr Disgraceful Lighting of Winchester, England.

[From the Hampshire Herald.]

Once more we consider it incumbent upon us, in the interest of the citizens generally, to revert to this subject, and urge the corporation, in the strongest possible manner, to take immediate steps to improve the, at present, highly discreditable state of our public lighting. Taken as a whole, we are confident that there is no city in the kingdom that is so wretchedly deficient in this respect as Winchester, and we may add that there is noother corporation, equally oblivious with our own to their constituents interests and comfort.

Of all the oil lamps in our city how many are there that give forth a tithe of the light which gas gives? We have no desire to exaggerate the point, but we believe there are not a dozen—and they are at the most noticeable parts of the city—that give anything approaching a conspicuous light; and if from these we go to the side streets, we find a dull glimmer here and there, which any member of the corporation would certainly consider inadequate to the lighting of the smallest room in his residence. What have the corporation done by going from gas to oil? What saving have they effected? And what benefit have they conferred upon the citizens? They have deprived the town of that sufficient and satisfactory illumination which it once possessed; they have plunged us into a disgraceful condition of semi-darkness, and they have effected a saving of £100 a year? "Saving," forsooth! Had we an equally good light with that which we had previously, there would certainly be a title to credit for economy, but, under the circumstances, we fail to see where there is any saving whatever, since it is one of those "penny-wise and pound foolish policies which has hitherto characterized the present corporation, to cast aside a good material and effect a so-called "saving" of £100 per annum by supplying one of not half its value. We presume we shall hear something of this kind in November; but if the retiring gentlemen will speak out honestly, they will account for their so-termed saving as would any schoolboy who, accustomed to speculating in penny cakes, only invested half that amount, and thus "saved" a halfpenny! Now, we will direct our readers attention to another fact worthy of consideration. The corporation and some of the citizens thought that the gas company asked a large and exorbitant price for their gas; but was this really so? Our readers will believe us when we state that we have neither consideration nor respect for them beyond what should be extended to all tradespeople and companies; and that we should not for a moment hesitate to write against this or any other company were they extortionate in their demands. As journalists, we espouse the cause of the people, and the people only, and whilst writing on important public topics, we are unmindful of every interest but theirs. The question we have asked is—Were we asked to pay an exorbitant price for gas when the city was lighted by the company?

Any one may satisfy himself upon this point by referring to the filed accounts in the clerk of the peace's office, they being perfectly public property. We have inspected them, and what do we find? That the dividends have risen one per cent. since the contracts were annulled, which shows clearly that there was exceedingly little profit derived from the lighting, and that the loss of the contract was rather a boon to the shareholders in the company rather than a source of loss.

The last dividend was 8 per cent., that for the previous half year was only 7 per cent., and this fact alone—there being no extraneous cause for the difference—shows that the company were absolutely at a loss in supplying the city. Comparing the two systems, we should consider gas preferable to oil, even did it cost not simply so much as formerly, but a few hundreds more; and we have not the slightest doubt whatever that if one or two influential tradesmen were to take the matter up, and draft a memorial for presentation to the council in favor of gas, it would be almost unanimously signed, for it is a reproach to a city like Winchester that we should so far lack in public spirit, and be content to remain so far behind other cities.

The dark cold nights of winter will soon be upon us, and what use will the oil lamps then be? The wind will cause the glass to become smoky and blackened; the lights will be all but useless; and should it happen that our city is enshrouded in impenetrable gloom, whom can we thank for it but the town council? We trust that the day is not far distant when such pressure will be brought to bear upon that body that the present contract will be cancelled, if that be achievable without injury to the gentleman who has it in hand, and when we shall have once more the pleasure of seeing our city properly illuminated.—*London Journal of Gas-Lighting.*

Testing Spots of Blood.

WITTSTEIN.

A commission appointed to examine tests of blood in criminal cases reports as follows:

1st. The microscope detects the form of the globules, when the blood is fresh, and distingnishes them from those of other animals. Certain liquids have a tendency to decompose blood—as water, especially hot water, acetic, gallic, hydrochloric, and sulphuric acid. The alkalies potash and soda, even in dilute solution, ether and chloroform, and several other reagents, cause blood corpuscles to entirely disappear. Spirit of wine, chromic and picric acid, and potassium dichromate, preserve the corpuscles, but change their form.

2d. The spectroscope: an aqueous solution colored peach-blossom red by hæmoglobin shows two absorption lines between D and E in the yellow and green, and the same rusult follows if blood is used instead o hæmogoblin. In doubtful cases, the hœmogoblin of the blood can be changed by a reducing substance. Reduced hœmogoblin has a different spectrum from that of normal hæmogoblin, viz., only one band as wide as the two others together, and a little to the left of the line D.

3d. Chemical analysis: In blood which is decomposed by itself or by acids or alkalies, the hæmogoblin is changed into hematin, and this combined with HCl gives crystals of a peculiar form. The experiment is performed as follows:

A little of the dried blood is laid on a glass plate, dissolved in a drop of water, a bit of NaCl is added, and the whole covered with a glass plate; a little acetic acid is allowed to reach the mixture through a crevice between the plates, and the whole is heated to boiling over a spirit lamp; more acetic acid is added, and the whole is again heated, and the process is repeated until crystals of a rhomboidal form and of a dirty brown color become visible under a microscope of from 300 to 400 magnifying power.

The above spectroscopic and chemical reactions are sufficient to detect with certainty very small portions of human blood.—*Am. Chemist.*

Prices of Gas Coals.

Quotations continue entirely nominal. The low cost of Newcastle, delivered in New England, continues to attract shipments to that market, The movement of domestic coal is confined almost exclusively to filling last season's contracts.

The fact that the bulk of the coal required in New York for 1878 has been contracted for, deprives the market of one of the important features of the trade at this season of the year. Some interest is manifested in the action of the combinations relative to the New England trade for 1878. If the arrangements of last year are continued, a large part of the supplies in that market will likely come from Newcastle and the Provinces.

Westmoreland	$5.50	$4.50	at Baltimore.
Penn	5.50	4.50	
Despard	5.35		
Marion	5.35		
Murphy Run	5.35		
Newburgh Orrel	5.35		
Ches. and Ohio RR. Caking Coal	5.40	$4.10 f. o. b. at Richmond.	
Block House	4.50	1.75	Gold f. o. b. at Mines.
Glace Bay	4.25	1.60	
International	4.25	1.60	
Clover Hill	4.00		
Cannelton Cannel	10 00		
Peytona	10.00		

AN ADULTERATION OF ESSENCE OF CLOVES.—E. Jacquemin.—Attention is called to the use of phenol for this purpose, and for its detection a small drop of aniline mixed with 5 or 6 c. c. of distilled water is recommended; this is added to the essence, then several drops of hypochlorite of soda. If phenol is absent, the color furnished by aniline alone is obtained a slight violet-purple, which is transitory; if present, a beautiful blue color is produced, which lasts for several minutes; 1 per cent may be detected.—*Ex.*

Globe Street Lanterns.

While the superior beauty of the Globe Street Lanterns over the old fashioned Square Lantern is universally conceded, the difficulty of removing the globe for the purpose of cleaning them has been a serious objection to their use. The Cameron Patent Globe Street Lantern, manufactured by the Cincinnati Safety Lamp Company is so constructed that the globe may be more easily removed and cleaned than the ordinary square lantern. These lanterns have been in use for about one year, and are giving general satisfaction. They cost less for repairs than other lanterns, are more durable. and offer less obstruction to the light, having but one supporting standard. They are certainly much handsomer than the square lanterns, and their first cost is but a trifle more. The manufacturers offer to send a sample lantern on trial to any gas company desiring to test the merits of their lantern. Any corporation about to purchase street lanterns, and all interested in improvements, will find it to their interest to correspond with the manufacturers. See advertisement in our advertising columns.—*Adv.*

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.

(with W. B. Scott & Co.,)

24 Pine Street, New York City.

February 2, 1878.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	Par.	Bid.	Asked.
Central, Westchester	466,000	50	85	90
Harlem	$1,850,000	50	90	95x
Manhattan	4,000,000	50	205	210
Metropolitan	2,500,000	100	130	133
" Scrip	$1,000,000	..	100	103
" Bonds	500,000	1000	92½	95
Mutual	5,000,000	100	88	90
" Bonds, gold.	900,000	1000	—	105
Municipal	1,000,000	100	90	100
New York	4,000,000	100	118	120
Suburban, W'steh'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	155	160
Citizens	1,200,000	20	75	80
" Scrip	320,000	1000	95	97½
Peoples	1,000,000	10	—	40
" Bonds	$ 325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	—	78
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	120	125
" Scrip		...	100	103
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	80	90
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	--
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	--
Fort Wayne, Ind		100	...	--
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L. I.	25,000	100	...	—
Jersey City	386,000	20	155	165
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown Maine	400,000	100	70	—
Lima, Ohio,	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo.	1,200,000	100	100	110
Long Branch		20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	--	27
" Bonds	350,000	1000	—	-
Peoples of Baltimore		25	—	56
" Bonds			106	---
Perth Amboy		25	—	95
Rochester, N. Y.		100	50	60
Woonsocket, R. I.	150,000	100	100	...
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97

Works: LOCKPORT, PA. *Established 1864.* Works: MT. SAVAGE JUNCTION, MD.

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Manufacturers of Clay Gas Retorts and Retort Settings,

"STANDARD SAVAGE"

Fire Brick, Tile and Furnace Blocks,

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The owner is obliged to dispose of them on account of ill health.

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The Handsomest, Cheapest and Most Durable Globe Street Lantern, *costs less for repairs* than the old-fashioned Square Lantern, and offers the *least obstruction to the light.* In use by the Cincinnati Gas-Light Company, the St. Louis Gas-Light Company. Greenville Gas-Light Company, Greenville, Mich, Etc.

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Having severed my connection with the Philadelphia Fire-Brick Works, of which I was superintendent for many years, I have associated myself with Cyrus Borgner, under the firm name of

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and have located in the Fire Brick Works, 23rd Street, below Vine (late Philip Newkumet's, deceased), where we are prepared to fill all orders promptly, and solicit your patronage.

447-1t W. J. O'BRIEN.

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BURLINGTON. N. J,

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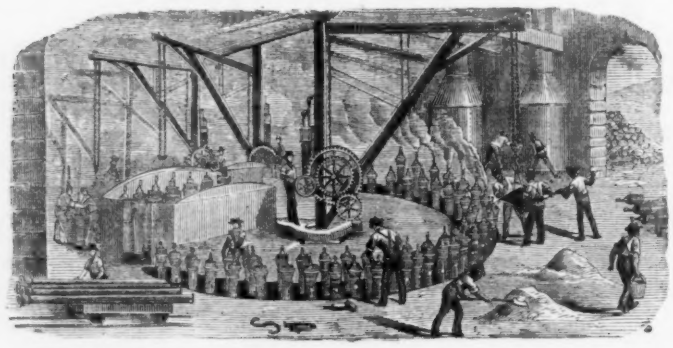

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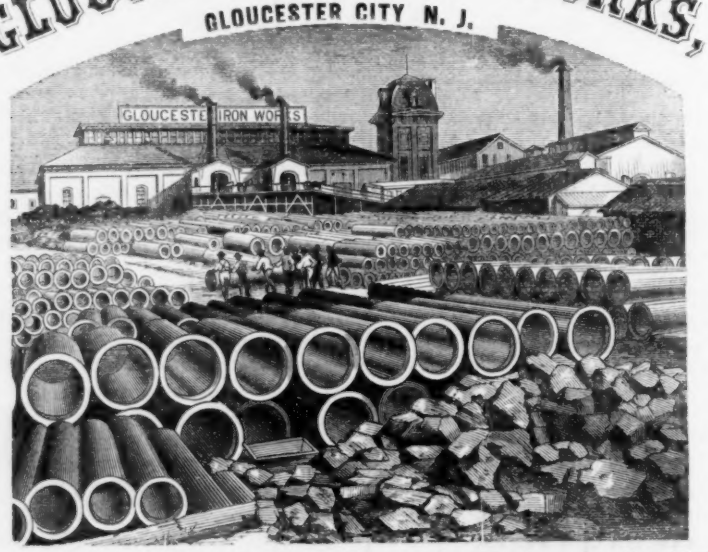

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FROM TWO TO FORTY-EIGHT INCHES DIAMETER.
ALSO ALL SIZES OF

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(Pipe from three inch and upwards cast *vertically* in 12 feet lengths.)

HEAVY AND LIGHT CASTINGS OF ALL KINDS.

DAILY CAPACITY 125 TONS.

☞ Our Works *connect direct* with *eleven railroads* center ng in this city, giving unequalled facilities for shipping o all points, at the lowest rates of freight. 405-1y

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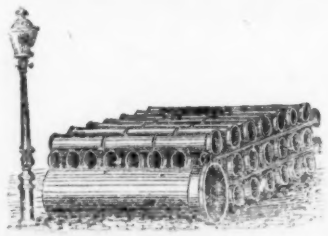
Manufacturer of all kinds of GAS and WATER PIPE BRANCHES, CONNECTIONS, T's, ELBOWS, and all CASTINGS USED AT GAS AND WATER WORKS,

We offer special inducements to parties wishing to purhase. My Pipe is Smooth, regular in weights, and cast vertically.

N. B.—Pipe from 3 inch and upwards, cast in 12-ft. lengths.
☞ SEND FOR CIRCULAR AND PRICE LIST.



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Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.
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To Gas Light Companies throughout the country.
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*** Reference to them is requested. 204-1

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MONTREAL, CANADA.
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GAS COALS.

THE
PENN GAS COAL COMPANY
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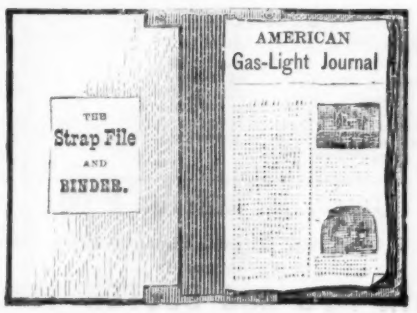

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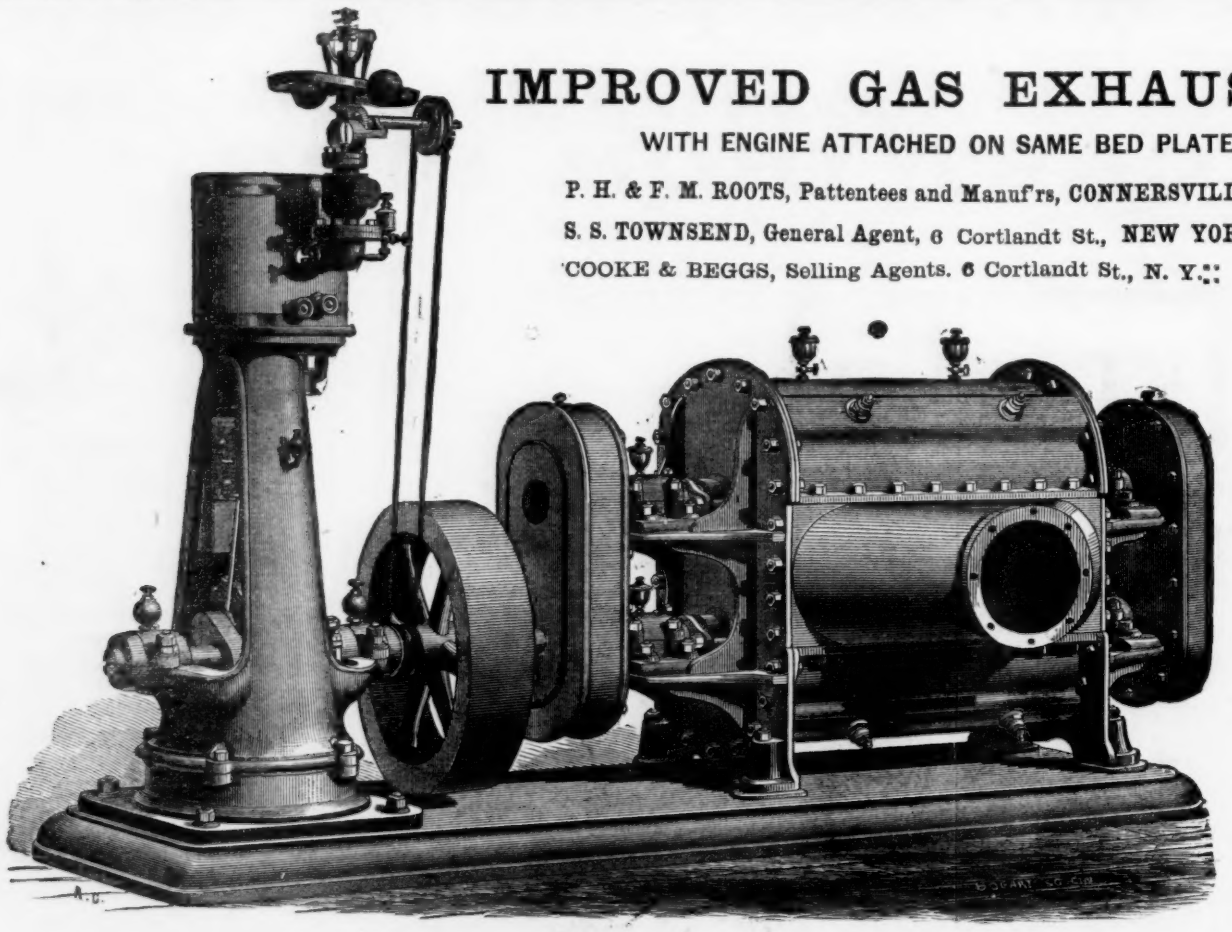

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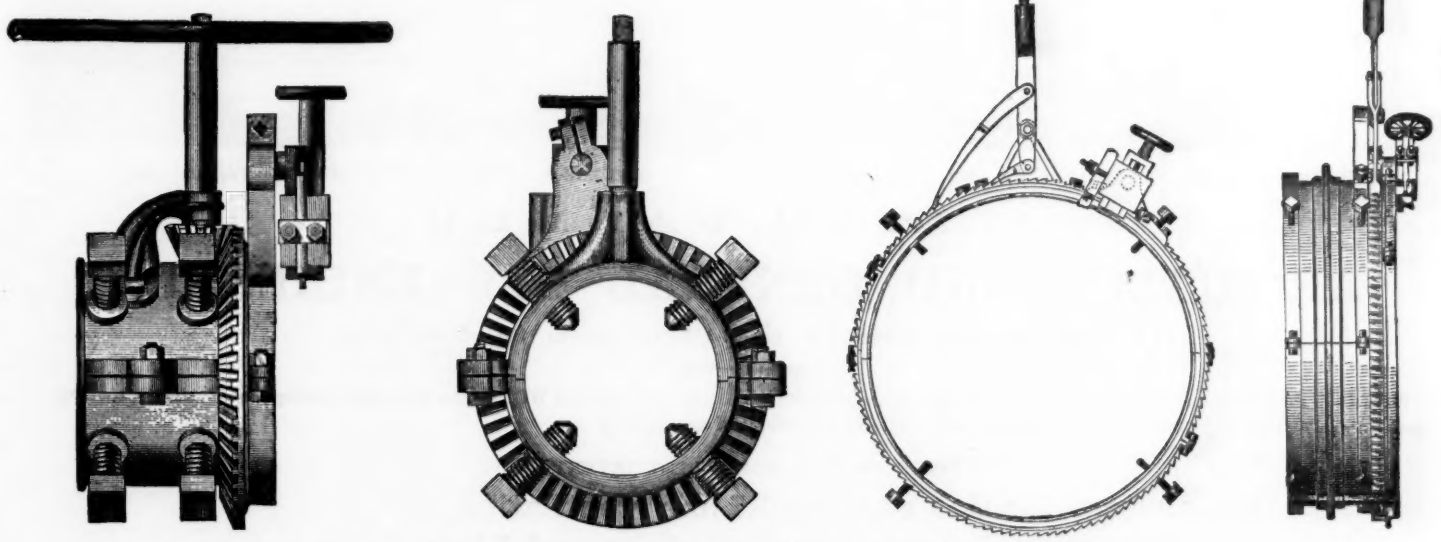
THIS IS THE ONLY HAND MACHINE IN THE WORLD FOR CUTTING

CAST IRON PIPE.



It will cut Cast or Wrought Iron Pipe, Shafts, or Columns of any size, making a clean, smooth, and square cut. Also,

A Continuous Line of Pipe in a Trench or Building.

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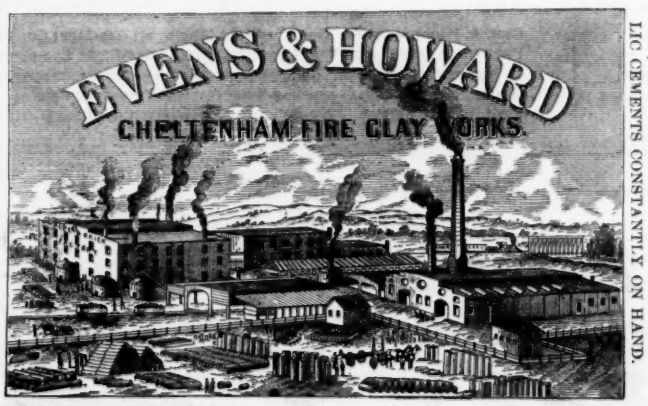

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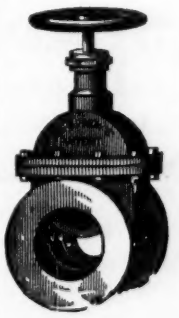

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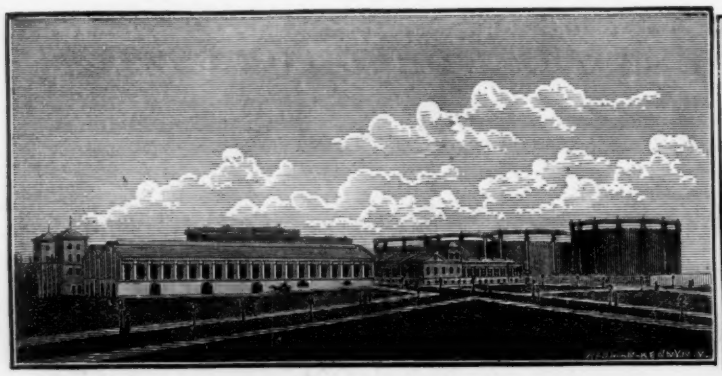
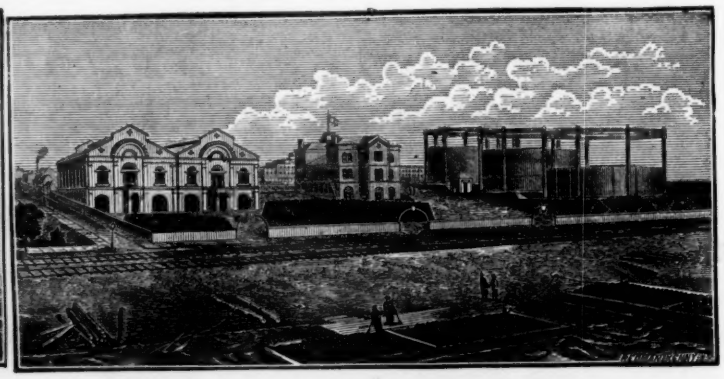


CINCINNATI GAS WORKS. ERECTED 1871-72-73.—WM. FARMER, ENG.



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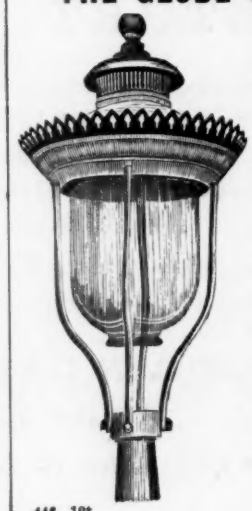

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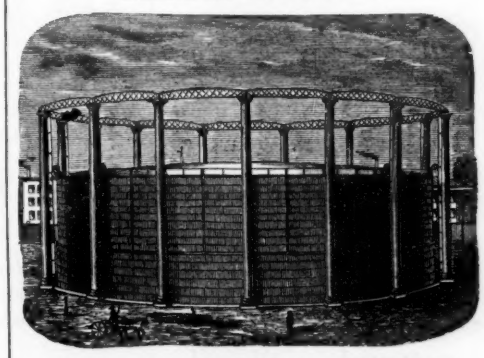

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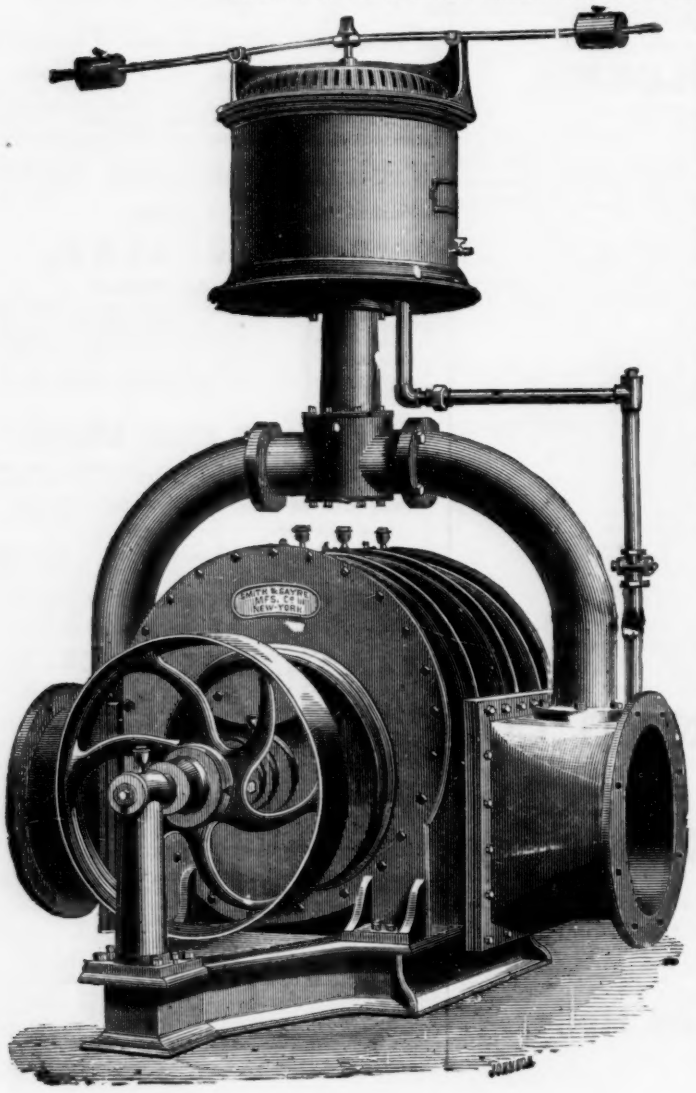

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